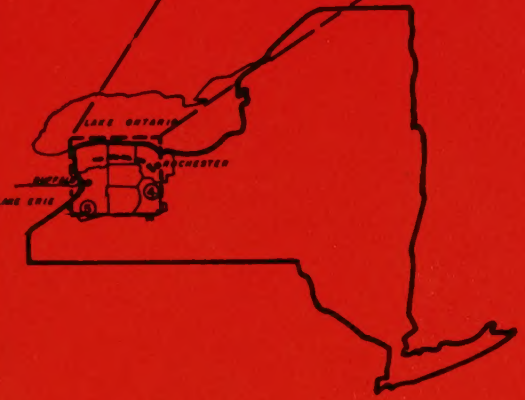
BARGE CANAL
WESTERN SECTION
LOCK 33 – LOCKPORT

FOUNDATION
INVESTIGATION
REPORT



SOIL MECHANICS BUREAU
NEW YORK STATE DEPARTMENT OF TRANSPORTATION

FOUNDATION INVESTIGATION REPORT

PHYSICAL CONDITION SURVEY

BARGE CANAL - WESTERN SECTION

LOCK 33 TO LOCKPORT

P. I. N. 4940.42 - 101
5940.21 - 101

LYNDON H. MOORE - DIRECTOR
SOIL MECHANICS BUREAU

ALBANY, NEW YORK

OCTOBER, 1977

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
Raymond T. Schuler, Commissioner

1220 Washington Avenue, State Campus, Albany, New York 12226

October 31, 1977

Mr. George M. Briggs, Director
Transportation Maintenance Division
NYS Department of Transportation
1220 Washington Avenue
Albany, New York 12232

Dear Mr. Briggs:

Subject: Transmittal of Canal Condition Survey Report
Lock 33 to Lockport
PIN 4940.42-101 and 5940.21-101

In accordance with your request dated December 16, 1974, this Bureau has completed a physical condition survey of the western section of the Barge Canal which extends between Fairport and Lockport. Our previous report submitted to your office on June 20, 1975, detailed conditions and recommendations for the canal section between Fairport to Lock 33. This physical condition study completes the remaining canal sections between Lock 33 and Lockport.

The report was formulated from comprehensive studies performed by personnel from the Soil Mechanics Bureau. These studies were based on comprehensive field inspections combined with the results of soil borings performed at designated locations along the alignment and a laboratory analysis of soil samples.

The recommendations in this report have been verbally transmitted to Mr. Sam Bowen of your office for areas requiring remedial treatment. In a few instances additional cross sections to define treatment end limits have been requested but not yet received. However, these sections will not influence the proposed treatments, only their extent.

Very truly yours,

Lyndon H. Moore, Director
Soil Mechanics Bureau

Lyndon H. Moore

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INTRODUCTION

The purpose of this report is to provide the Transportation Maintenance Division with a technical appraisal of foundation conditions along the Western section of the Barge Canal between Rochester and Lockport. Accepted engineering criteria has been used to evaluate the condition of the canal embankment and develop the foundation recommendations which are contained in this report.

On December 16, 1974, the Soil Mechanics Bureau was authorized to inspect and prepare any necessary foundation treatment recommendations for the Barge canal embankments between Rochester and Lockport. The initial section between Fairport and Lock 33 was to be completed first due to the high embankments which existed therein and the recent failure at Bushnell's Basin. In addition, this first report would determine the feasibility and relative cost of embankment repair treatments which could be applied to the remaining canal sections. A work plan was developed to accomplish this task. The purpose and scope are as follows:

> "PURPOSE - To develop long range monitoring and maintenance programs to provide continuous and efficient operation of the canal system and to insure public safety."
>
> "SCOPE - To inspect and document the condition of the present canal system; to evaluate the condition and prepare recommendations for future corrective and preventive maintenance and monitoring programs."

On June 20, 1975, a Foundation Investigation Report, Barge Canal, Fairport to Lock 33, was transmitted to your office. It is worthy of note that the vast majority of the canal embankments in this area required no remedial foundation treatment whatsoever. In addition the areas requiring treatment were able to be quickly and economically repaired. These treatments have provided effective stabilization and can be utilized in future studies.

The method of study involved a field inspection of the entire canal between Rochester and Lockport with several return inspections in marginal areas. After the initial field study, detailed ground survey cross section and subsurface explorations were obtained in selected embankment areas. In some cases several extensions of cross section limits were required to define the end limit of areas requiring treatment. Although all of these cross sections have not yet been received this data will not influence the type of treatment proposed, only the extent.

In the framework of this report we have briefly reiterated the criteria used to ascertain the adequacy of the canal embankments, developed contour plans of each area and presented detailed cross section data for each area requiring treatment. Two areas Culvert Rd. and Middleport, which required concrete channel lining were transmitted earlier under separate cover.

SUMMARY

Our field inspection, laboratory and design analyses indicate that 96 percent of the canal embankments between Lock 33 and Lockport conformed to accepted design criteria. The remaining areas which require some degree of embankment improvement are included within the body of this report.

BARGE CANAL FIELD INSPECTION

During the past 2 years representatives of the Soil Mechanics Bureau have made numerous field inspections of the canal embankment between Rochester and Lockport. The inspections were done in both winter and summer to observe the canal in operation and dewatered. The object of the initial inspections was to identify general areas which appeared to require remedial treatment. At the time of these initial inspections, only 1:24000 U.S.G.S. topographic maps were available to assess ground contours. Cross sections were then obtained and analyzed to determine if the areas were substandard. Additional field inspections were made with these cross sections in hand to layout subsurface explorations and to determine the limits of treatment in the field. Additional cross sections were obtained to define treatment end limits.

The inspection procedure consisted of traversing the 60 mile long subject canal section to locate areas of seepage and areas of high or steep embankment slopes. The primary purpose of this inspection was to evaluate existing embankment stability and assess related factors on its long term performance. Areas of suspected seepage were tested by injecting a dye into the canal and observing the outboard embankment for its emergence. None of the areas tested showed any dye emergence. Structures extending through or under the canal were inspected only for foundation instability. Observations and opinions regarding the structural condition are presented in a separate report by the Materials Bureau.

ANALYSIS OF CANAL EMBANKMENTS

Our analysis of the canal alignment was based on embankment stability criteria, earth dike design, seepage considerations, and standard structure design practices. These analyses were used to estimate a "condition classification" and to determine recommended foundation treatment. The standard design sections used in this report for canal embankments are in accord with data contained in "Guidelines for the Construction of Small Earth Dams" published by New York State Department of Environmental Conservation. This represents the current best engineering practice and the professional judgment of staff engineers of the State Department of Transportation and the State Department of Environmental Conservation with assistance by the staff of the Soil Conservation Service, United States Department of Agriculture. The above publication is based upon earth dam design criteria established in "Design of Small Earth Dams," 1961, United States Department of the Interior - Bureau of Reclamation.

Supplementary analyses involving laboratory grain size analyses of soil samples were made to determine the resistance of the existing soils against piping or cracking. Piping is defined as the movement of soil particles as the result of unbalanced seepage forces produced by percolating water, leading to the development of boils or erosion channels.

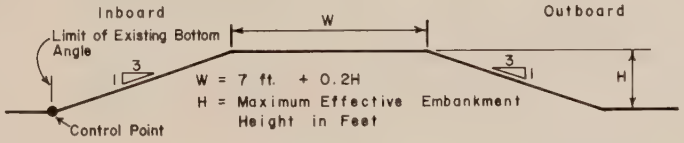
In general, the existing materials offer "intermediate" resistance to piping. That is, the soils will safely resist saturation of the lower portion of the downstream slope indefinitely. However, sloughing of oversteepened side slopes may open small leakage channels which would cause erosion and lead to eventual failure. Therefore, an objective of this study is to find and flatten any oversteepened slopes in sub-standard areas. Cracking due to differential settlement occurs in embankments a few years after construction. Normal due to poorly compacted cohesionless soils, this phenomena causes small openings near the embankment top surface which may lead to piping. In general, the existing soils probably were subjected to cracking when initially constructed. However, these embankments have been safely in place for many years and no further effects due to cracking are expected. The results of the pertinent laboratory testing are plotted on later pages adjacent to the appropriate cross section and labeled "Soil Sample Grain Size Distribution". The typical gradation bands for estimating piping and cracking potential are excerpted from Technical Memorandum 645 of the U.S. Department of Interior, Bureau of Reclamation entitled, "Influence of Soil Properties and Construction Methods on the Performance of Homogeneous Earth Dams" by J. L. Sherard.

The following is a brief explanation of the geometry of the standard design canal embankment sections developed for this project.

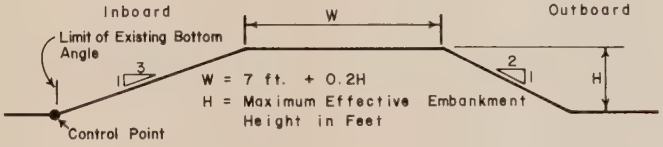
1. Inboard canal embankment slopes steeper than 1 vertical on 2 horizontal can be expected to slough or be susceptible to isolated failures due to sudden drawdown of canal water or excessive saturation due to run-off from storm water. It is not expected that these conditions would deteriorate the inboard slope beyond 1 vertical on 3 horizontal since annual maintenance is done on the inboard slopes. Therefore for determining required embankment widening it was assumed that all inboard slopes would eventually have a 1 vertical on 3 horizontal inclination.
2. The purpose of the top width requirement (W) is to provide sufficient embankment width to prevent the theoretical line of seepage from emerging on the outboard slope. Many areas on this project have an embankment top width (W) far in excess of the recommended. Areas which have side slopes much steeper than the recommended may be quite stable overall, if the top width is great. We do not recommend flattening slopes, except for maintenance cost reduction, of any section that has adequate top width based on application of the standard canal embankment section criteria; that is, any section on which the standard section is completely contained within the existing embankment section.
3. The inclination of the outboard slope is specified at 1 vertical on 3 horizontal to provide embankment stability. If seepage control measures are utilized a steeper allowable slope i.e., 1 vertical on 2 horizontal, is justified because seepage forces are reduced and embankment stability increased.

The existing canal embankment sections were compared with the standard

design sections for canal embankments shown below. This comparison is effected by establishing the inboard toe of slope (or limit of bottom angle) as a control point and then overlaying the existing cross-section with the appropriate standard section. The "sub-standard embankment sections" referred to [redacted] in the text are existing embankments whose geometry does not conform to the criteria shown below:



Standard Design Section for Canal Embankments Without Seepage Control Measures



Standard Design Section for Canal Embankments With Seepage Control Measures

A separate analysis was performed to account for the affect of earthquakes on embankment stability. The details of this analysis are contained in Appendix B. The results of this analysis indicate that the standard design sections shown above will be stable for the expected earthquake intensity.

Based on the results of our field inspection of the canal embankments we have classified the condition of each area into one of four categories. These categories are as follows:

Condition Classification	Description
Class 1	Immediate Positive Treatment Required
Class 2	Future Improvement Required
Class 3	Minimal Maintenance or monitoring required
Class 4	No treatment required

The station by station analyses which are shown in the text outline the general physical description and foundation problems within each canal area. Recommended foundation treatment is shown to correct the foundation problems noted thereon.

The entire subject canal area was classified with the following results:

Condition Classification	Percent of Total Area
Class 1	0.1
Class 2	3.9
Class 3	0.5
Class 4	95.5

FOUNDATION TREATMENT CONSIDERATIONS

The recommended foundation treatment shown on the station by station summaries should be accomplished using established procedures.

A. Canal Embankment Widening

The treatment limits shown on the station by station summaries for embankment widening or slope flattening are only approximate. In all areas where these treatments were recommended, end limiting sections should be obtained. These cross-sections will be used to determine the actual limits of treatment. Widening or flattening operations should be progressed as follows in areas where sufficient right of way exists.

1. Strip all topsoil, sod, and vegetation from area to be improved.
2. Extend any existing drainage structures beyond toe of improved slope.
3. Bench existing embankment in accordance with New York State Department of Transportation Standard Sheet 203-2 before placement and compaction of additional embankment.
4. Embankment material and placement procedures should be in accord with Section 203 of the New York State Department of Transportation Standard Specifications of January 1, 1973. Additional required embankment material should be Item 12203.26 - Crusher Run.

In areas of limited right of way, embankment widening or slope flattening may be accomplished by constructing a concrete retaining wall near the right of way limit.

1. These walls should be designed in accordance with Figures 20A or 20B, Section 20 of the New York State Highway Design Manual or EI 76-69 for Precast Concrete Wall Units.
2. Any utilities which must be extended through the wall should be independent of the wall and surrounded with filter material.

B. Seepage Control

Positive, permanent elimination of seepage is difficult and expensive to achieve. The primary purpose of the seepage treatments recommended in this report is to prevent embankment instability due to seepage forces or piping and to substantially reduce large losses of canal water.

1. Any drainage structures which are now defunct or will be abandoned in the future should be positively blocked.
2. All existing drainage pipes which are to be extended in connection with remedial embankment treatment should be fitted with anti-seep collars to increase flow path by 15 percent.
3. Sheet pile walls which are recommended for seepage cutoff should be installed at the centerline of the top of embankment.

In areas where sheeting cannot penetrate to the desired depth, pressure grouting may be required to seal the zone below the sheeting toe.

C. Drainage Structures

The inspection disclosed that all of the drainage structures in this section were stable. However, all existing functional drainage structures and outlet channels must be periodically cleaned of silt and debris to prevent clogging and the resulting build-up of seepage forces.

The Materials Bureau has completed a comprehensive study of the structural condition of the drainage structures between Fairport and Lockport. This report entitled, "Structure Condition Report - Fairport to Lockport" and dated Feb. 28, 1977, should be consulted prior to any culvert extensions to determine the extent of remedial treatment for the structure.

D. Slope Vegetation

Vegetation is planted on embankment slopes to minimize surface infiltration, prevent surface sloughing and to beautify the area. Certain types of vegetation such as grass, shallow rooted plants or creeping vines are well suited to this task. However, natural indiscriminate regeneration such as large bushes, trees and other dense, high vegetation tend to mask or create slope problems.

At the present time such dense vegetation exists on the canal slopes as to make inspection an extremely difficult job at best. In addition a large number of trees which vary in diameter from a few inches to several feet, grow on the slopes.

These trees present a multi-faceted problem. If the trees continue to grow, the root growth will continue to damage culverts and the interior concrete lining of the canal. Large trees present the greatest problem. This problem is most severe in areas where narrow substandard embankments exist. The roots also provide a natural seepage path for water from the canal. Selective thinning of smaller trees may increase the chance of toppling large trees due to the destruction of the "canopy effect."

If the trees are cut and not poisoned, root growth may continue indefinitely and only the problem of sudden failure has been alleviated. If the stumps are poisoned and die, decay will occur over a period of years and may create seepage problems.

After careful consideration of this problem we recommend the following treatment.

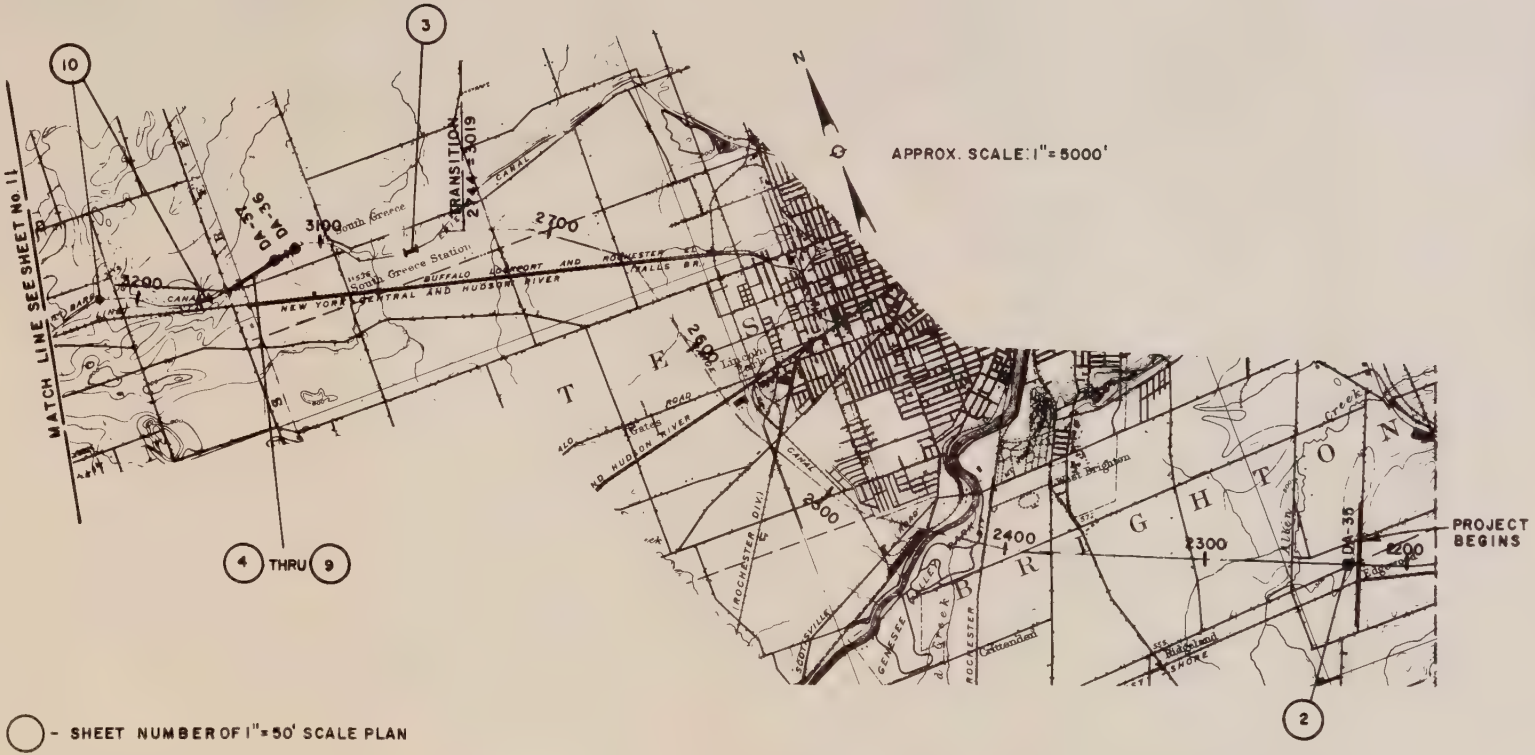
1. Remove and control all undesirable vegetation except grass and shallow creepers on slope areas with Class 1 or 2 condition classification. Remove all trees and poison the remaining stumps.

2. For all other slope areas i.e., condition classification 3 or 4, remove and control regrowth of dense high vegetation. Remove all trees with diameters 6" or less and poison the stumps. Removal of larger trees is not required as the stability of embankments under classes 3 and 4 would not be endangered if these large trees were suddently toppled or uprooted.

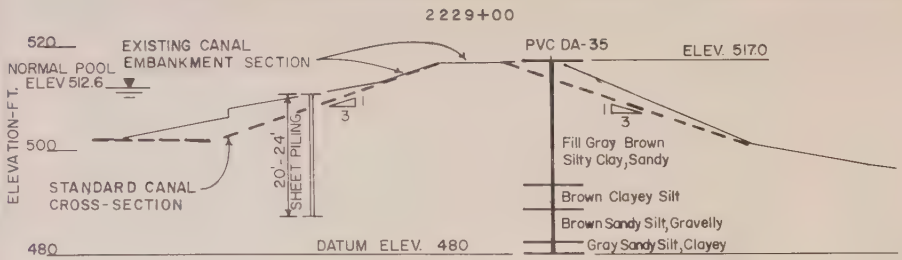
3. All stump poisoning and vegetation control should be done in accordance with the New York State Department of Transportation Herbicide Manual prepared by the Landscaping Bureau in March, 1975.

4. Any areas which undergo complete removal of vegetation should be mulched and seeded immediately in order to prevent erosion by surface runoff.

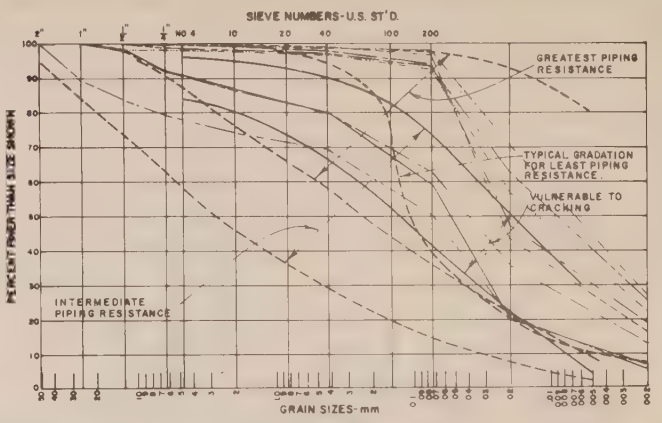
CANAL, PLANS, CROSS-SECTIONS AND RECOMMENDATIONS


MATCH LINE SEE SHEET No. 11
10
3
TRANSITION
2+44 = 3019
DM-36
3100
South Greece
South Greece Station
3200
2700
BUFFALO
NEW YORK CENTRAL AND HUDSON RIVER
ROCHESTER
N
APPROX. SCALE: 1" = 5000'
T E S S
2800
Lisbon
Gates
OLD
MT HUDSON RIVER
CANAL
ROAD
8000
ROCHESTER DIVI
SCOTTSVILLE
GENESEE
Creek
ROCHESTER
Greenfield
2400
2300
DM-35
2200
PROJECT BEGINS
Creek
Brighton
Rutland
SMOKE
4 THRU 9
2
- SHEET NUMBER OF 1" = 50' SCALE PLAN

SHEET No. 1



SECTION A-A
SCALE 1" = 20'



JAR-J-1 — — — J-5 — · · · — · · ·
J-2 ——— J-6 — — · — · —
J-3 - - - - - J-7 - - - ——
J-4 — - - — J-8 - - — ——

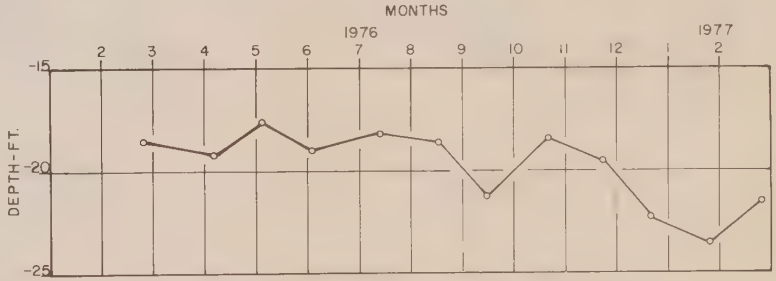
SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-35

Canal C/L Station

2228+50 - 2232+50

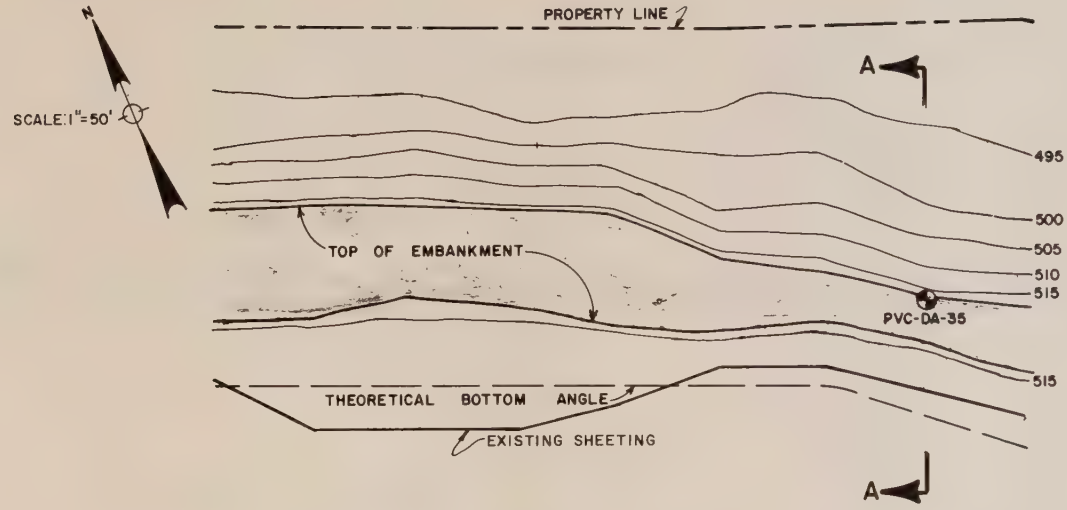
Condition Classification
Class 4

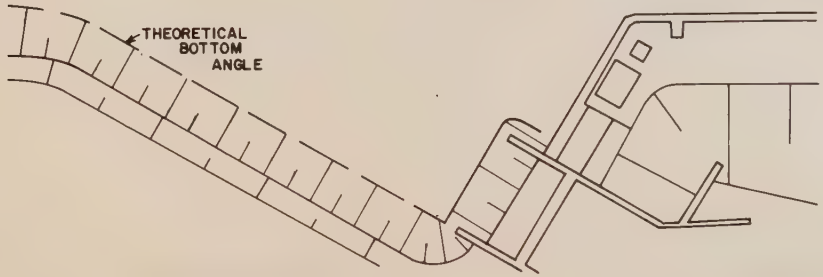
Recommended Foundation Treatment
None

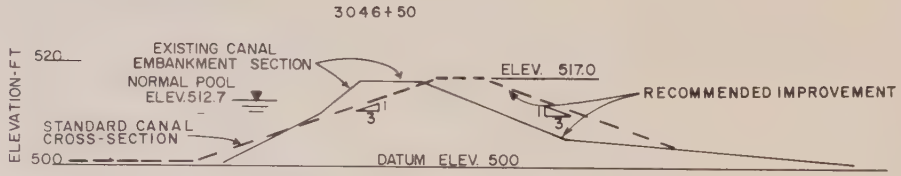


SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-35

SHEET No. 2-1


N
SCALE: 1"=50'
PROPERTY LINE
A
495
500
505
510
515
TOP OF EMBANKMENT
PVC-DA-35
515
THEORETICAL BOTTOM ANGLE
EXISTING SHEETING
A
2232
2231
2230
2229
℄ OF CANAL


THEORETICAL
BOTTOM
ANGLE



SECTION B-B
SCALE 1" = 20'

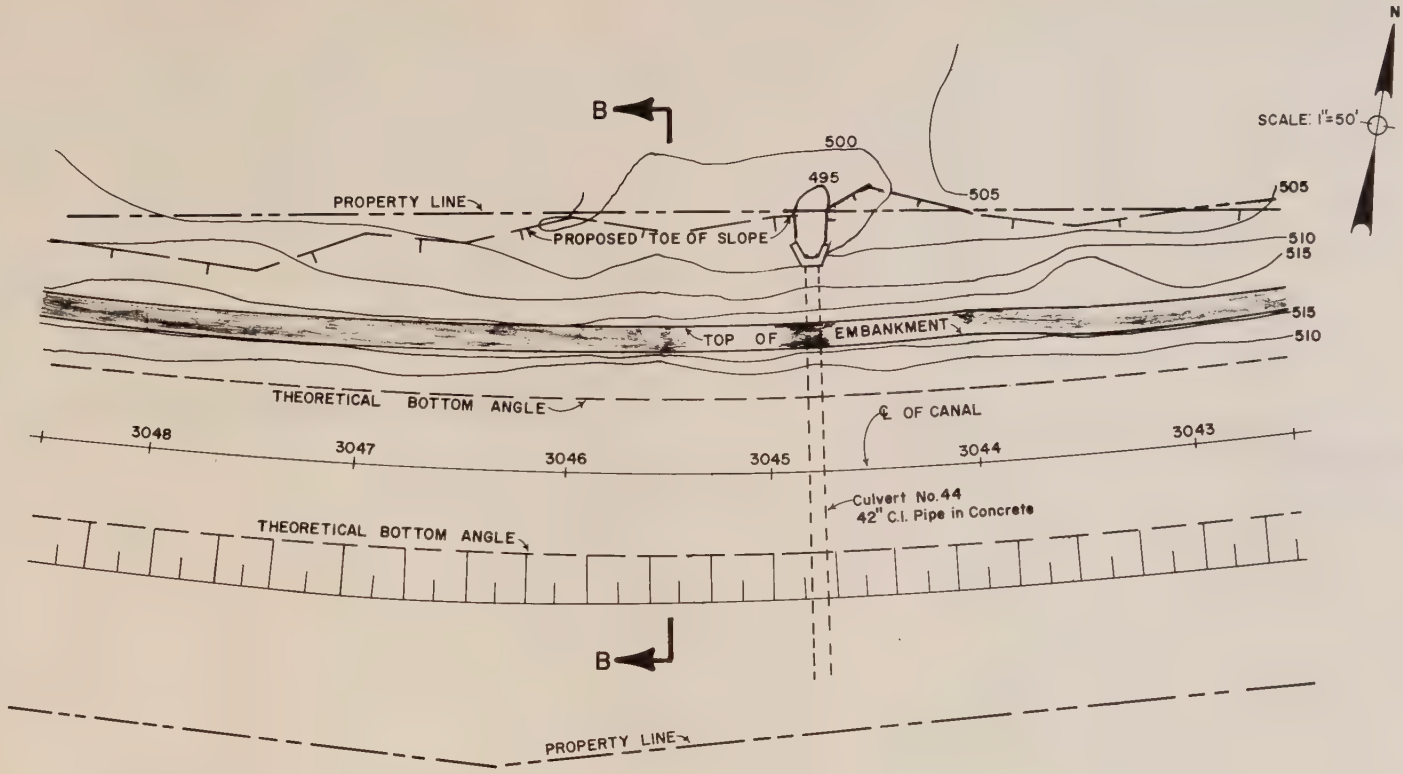
Canal C/L Station

3042+50 - 3048+50

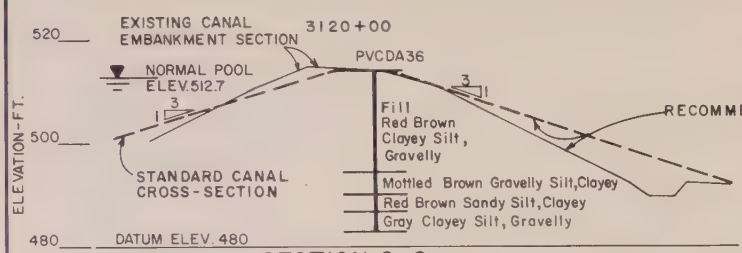
Condition Classification
Class 2

Recommended Foundation Treatment

Widen embankment on outboard side as shown in Section B-B.
Extend culvert No. 44 to limit of proposed embankment.

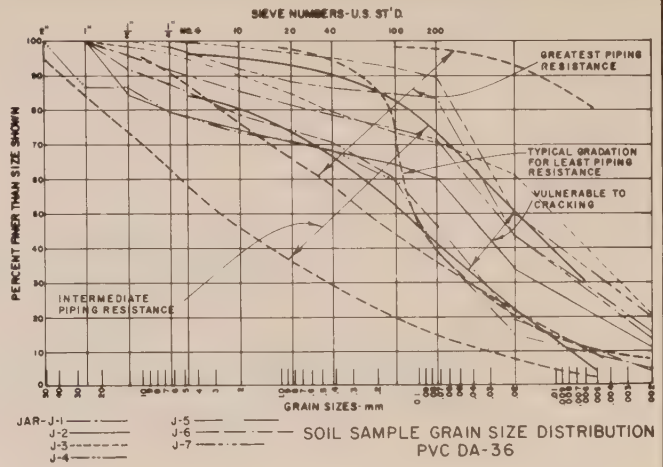

N
SCALE: 1"=50'
B
500
495
505
PROPERTY LINE
PROPOSED TOE OF SLOPE
505
510
515
515
TOP OF EMBANKMENT
510
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3048
3047
3046
3045
3044
3043
Culvert No.44
42" C.I. Pipe in Concrete
THEORETICAL BOTTOM ANGLE
B
PROPERTY LINE

SHEET No. 3



SECTION C-C

SCALE: 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-36

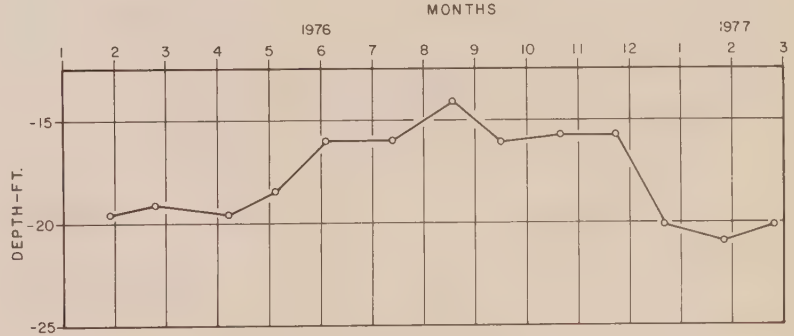
Canal C/L Station

3114+00 - 3135+50

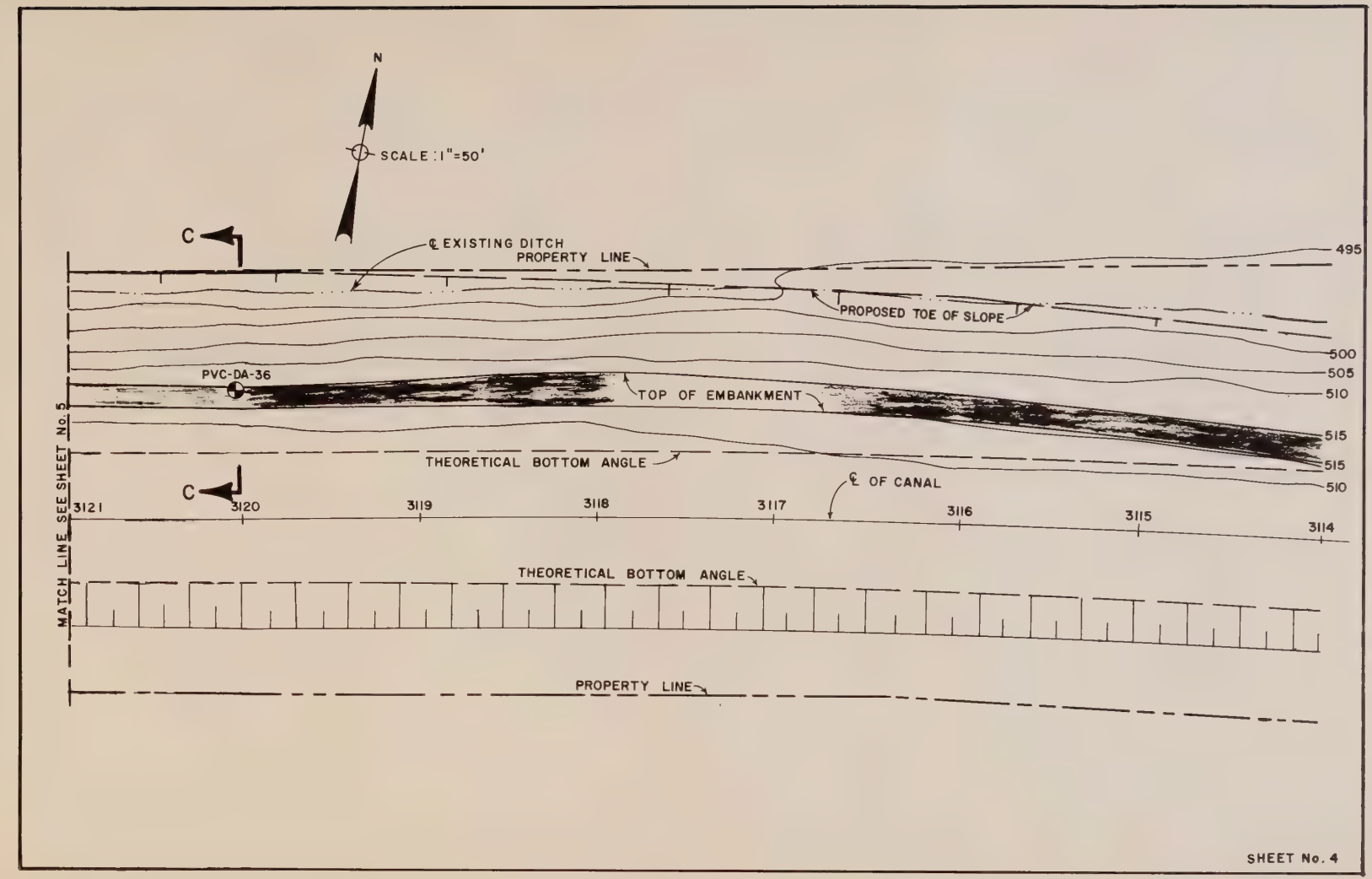
Condition Classification
Class 2

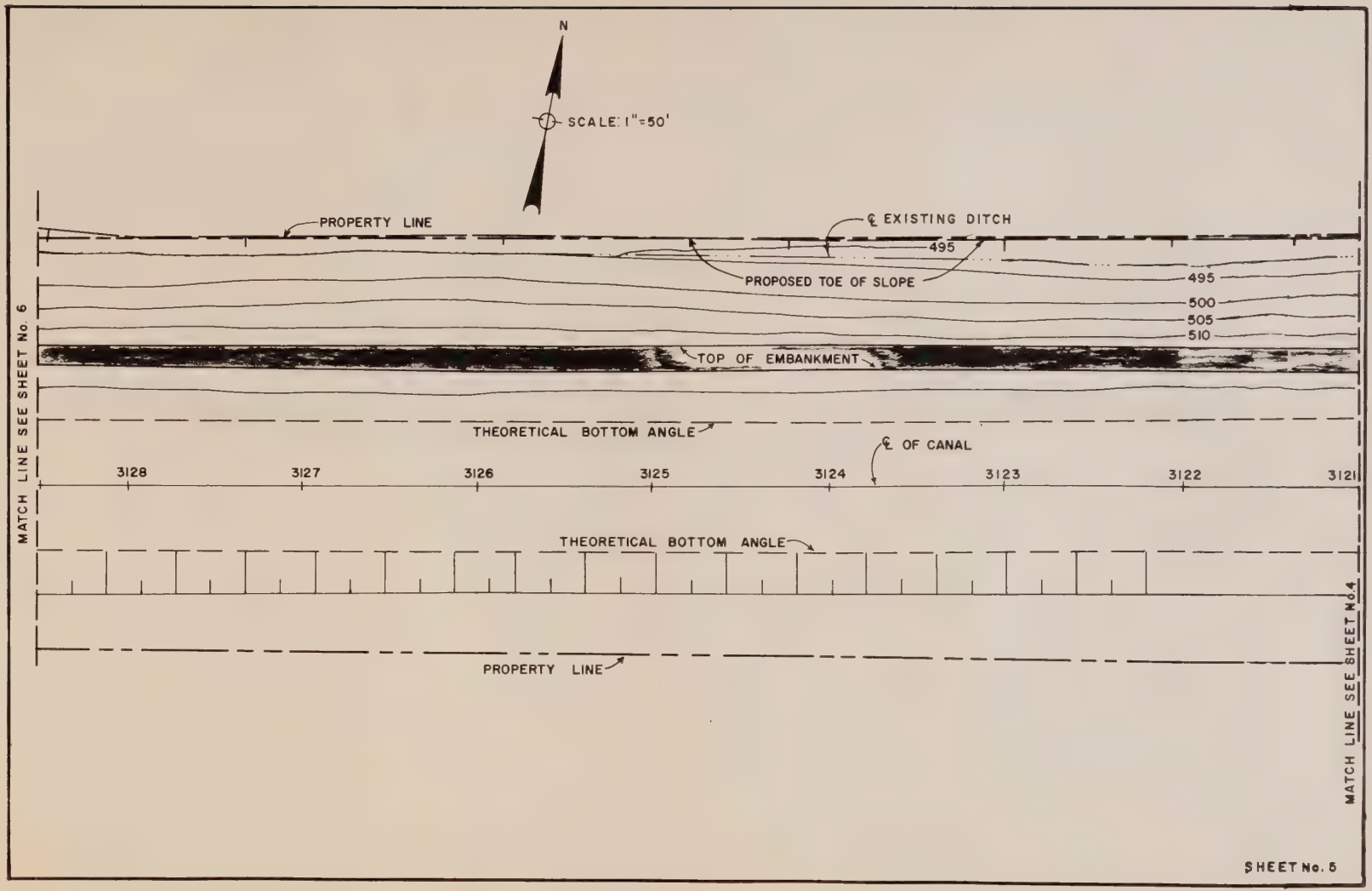
Recommended Foundation Treatment

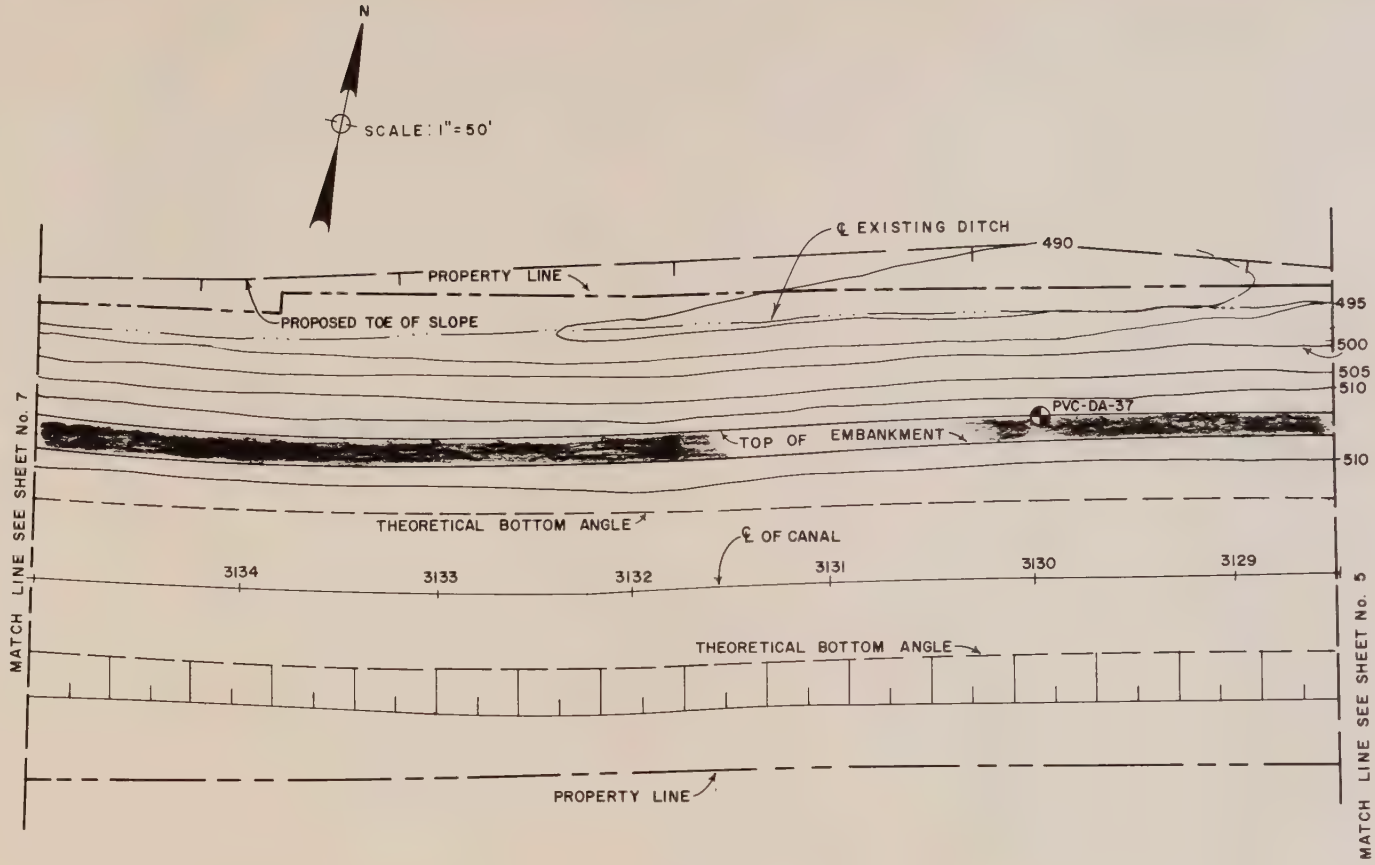
Widen embankment to criteria shown on Section C-C and end slope limits shown on sheets 4 to 7

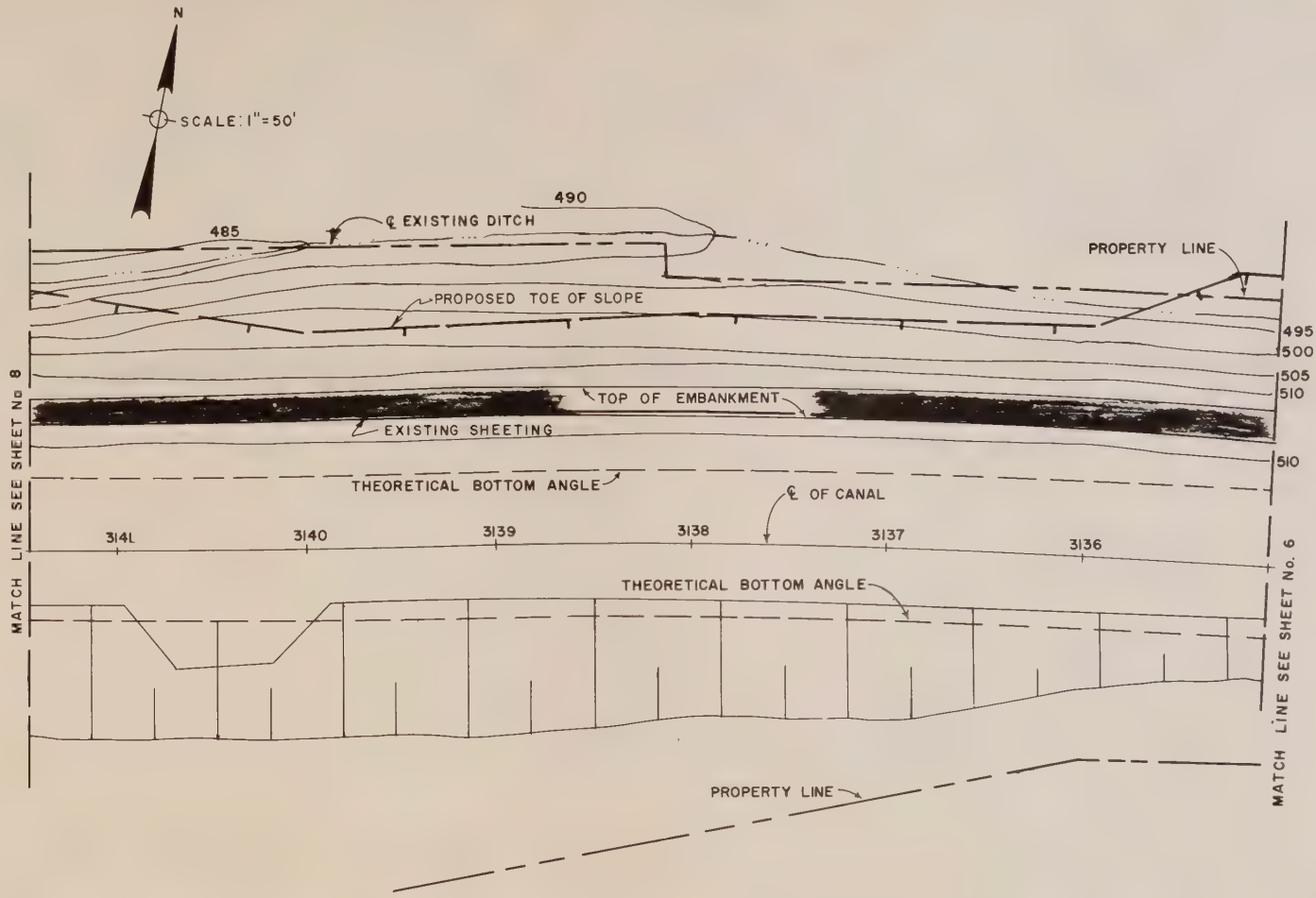


SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-36

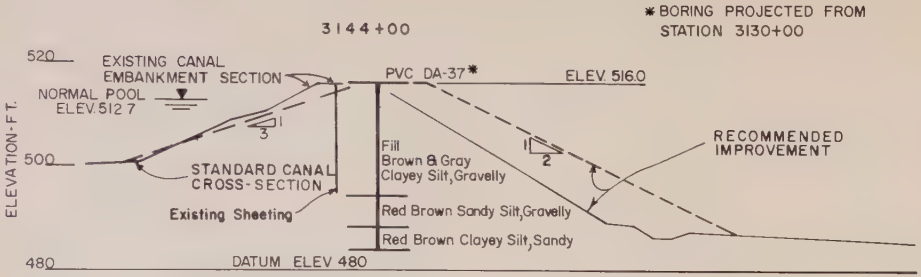

N
SCALE : 1"=50'
C
℄ EXISTING DITCH
PROPERTY LINE
PROPOSED TOE OF SLOPE
495
500
505
510
515
515
510
PVC-DA-36
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3121
3120
3119
3118
3117
3116
3115
3114
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 5
SHEET No. 4


N
SCALE: 1"=50'
PROPERTY LINE
℄ EXISTING DITCH
495
PROPOSED TOE OF SLOPE
495
500
505
510
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3128
3127
3126
3125
3124
3123
3122
3121
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 6
MATCH LINE SEE SHEET No. 4
SHEET No. 5

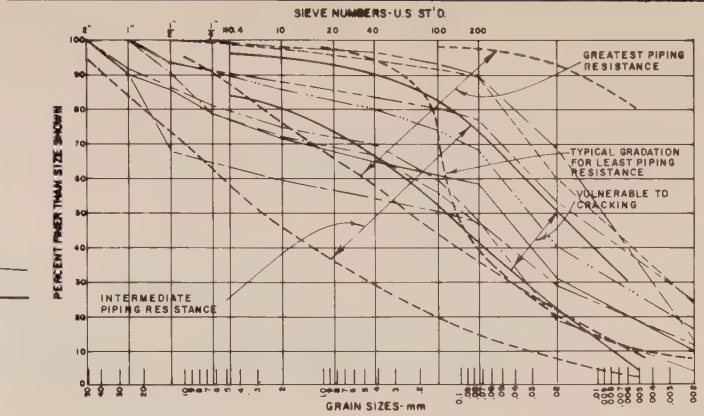

N
SCALE: 1"=50'
℄ EXISTING DITCH
490
PROPERTY LINE
PROPOSED TOE OF SLOPE
495
500
505
510
PVC-DA-37
TOP OF EMBANKMENT
510
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3134
3133
3132
3131
3130
3129
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 7
MATCH LINE SEE SHEET No. 5


N
SCALE: 1"=50'
490
485
℄ EXISTING DITCH
PROPERTY LINE
PROPOSED TOE OF SLOPE
495
500
505
510
TOP OF EMBANKMENT
EXISTING SHEETING
510
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3141
3140
3139
3138
3137
3136
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No 8
MATCH LINE SEE SHEET No. 6
PROPERTY LINE

SHEET No. 7



SECTION D-D
SCALE 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-37

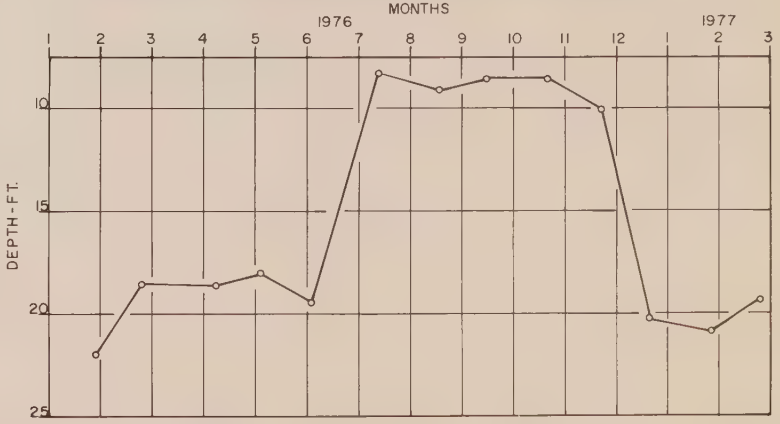
Canal C/L Station

3135+50 - 3153+00

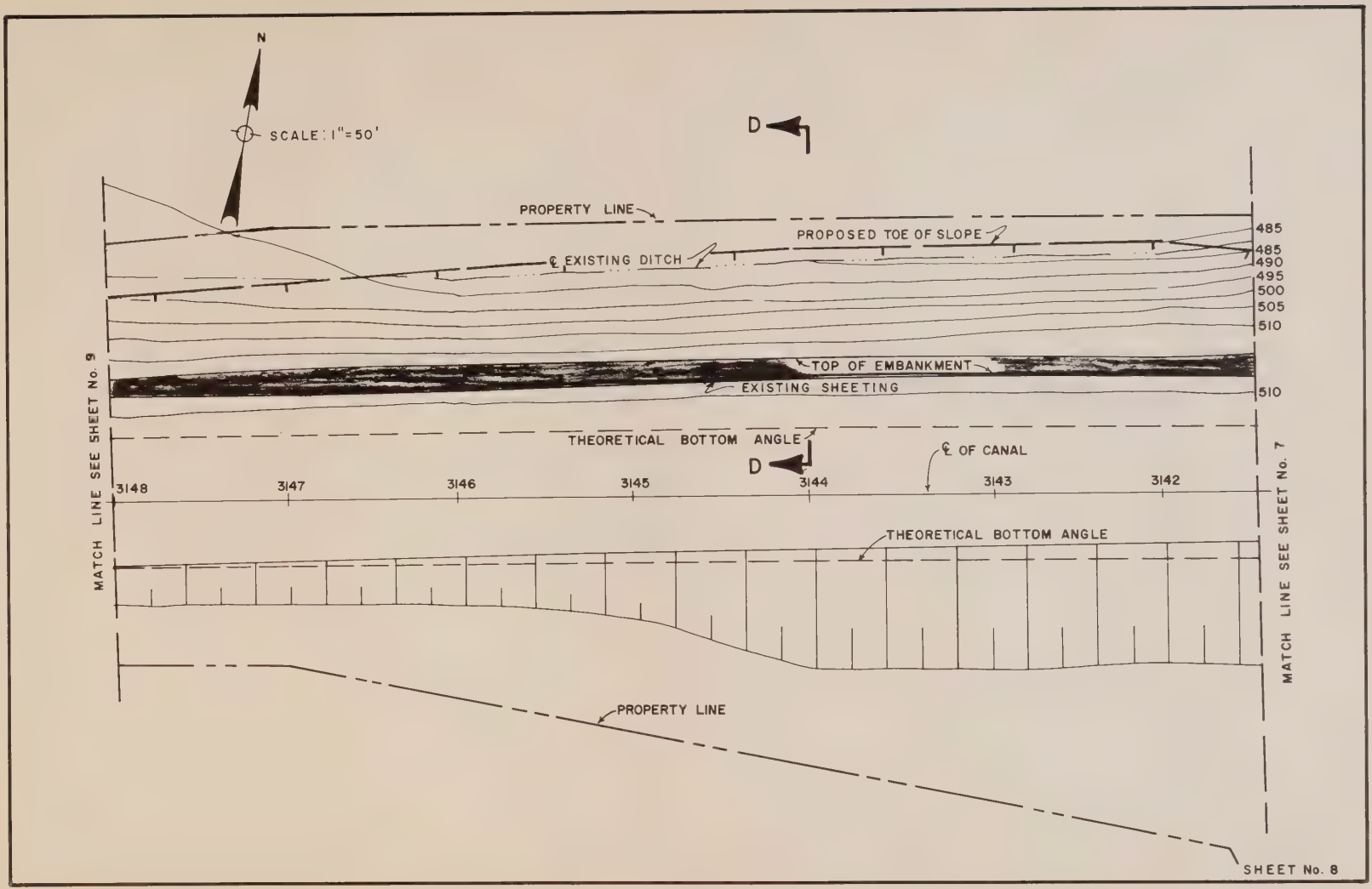
Condition Classification
Class 2

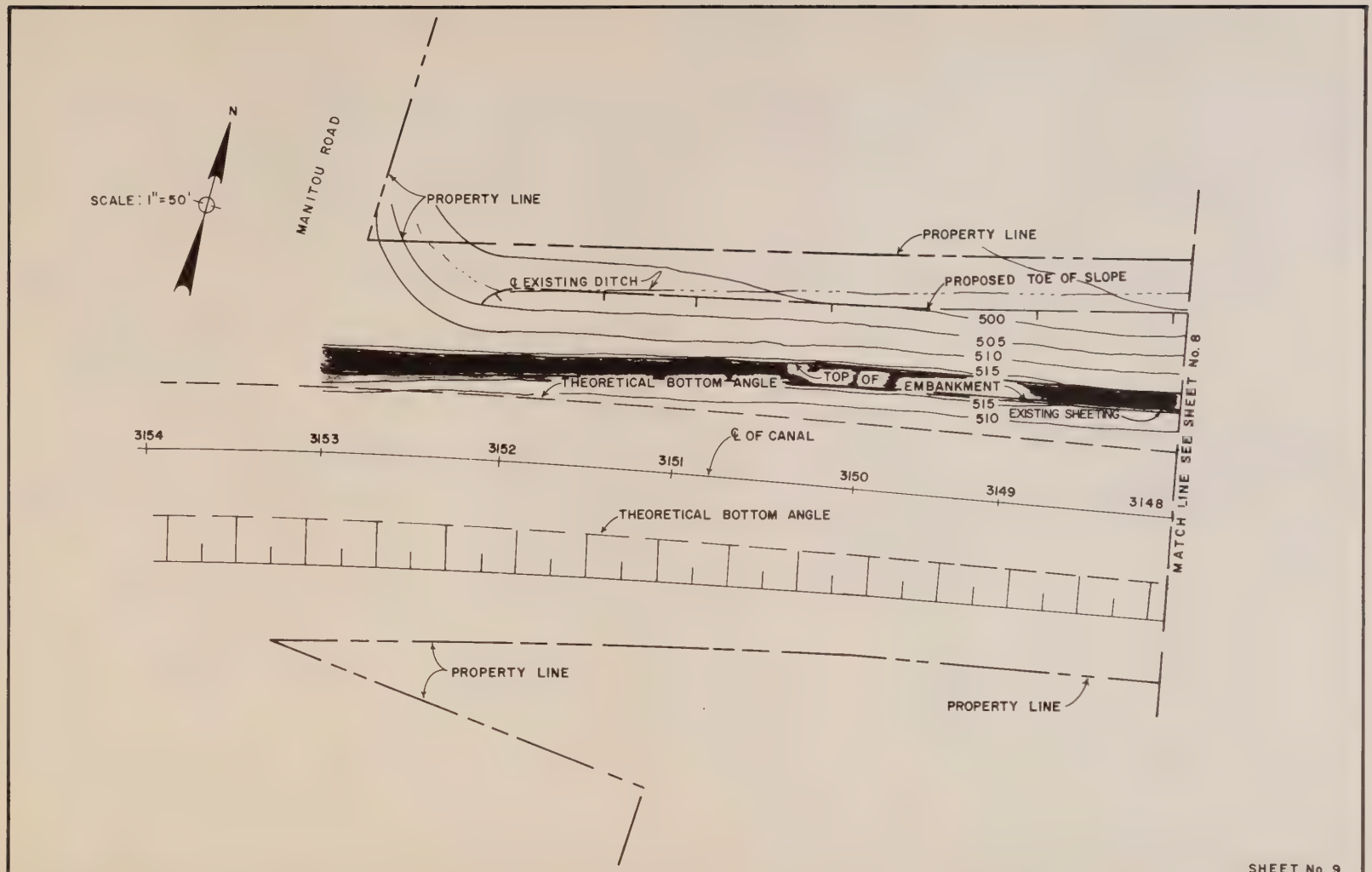
Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section D-D and end slope limit shown on sheets 7 to 9

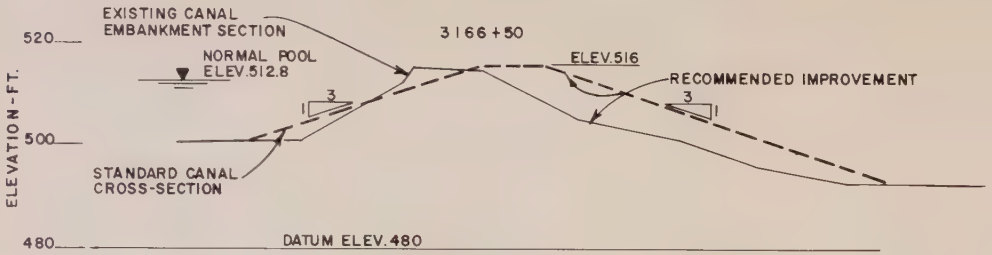


SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-37


N
SCALE: 1"=50'
D
PROPERTY LINE
PROPOSED TOE OF SLOPE
℄ EXISTING DITCH
485
485
490
495
500
505
510
TOP OF EMBANKMENT
EXISTING SHEETING
510
THEORETICAL BOTTOM ANGLE
D
℄ OF CANAL
3148
3147
3146
3145
3144
3143
3142
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 9
MATCH LINE SEE SHEET No. 7
SHEET No. 8


N
SCALE: 1"=50'
MANITOU ROAD
PROPERTY LINE
PROPERTY LINE
℄ EXISTING DITCH
PROPOSED TOE OF SLOPE
500
505
510
515
THEORETICAL BOTTOM ANGLE
TOP OF EMBANKMENT
515
510
EXISTING SHEETING
MATCH LINE SEE SHEET No. 8
3154
3153
3152
3151
℄ OF CANAL
3150
3149
3148
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
PROPERTY LINE

SHEET No. 9



SECTION E-E
SCALE: 1"= 20'

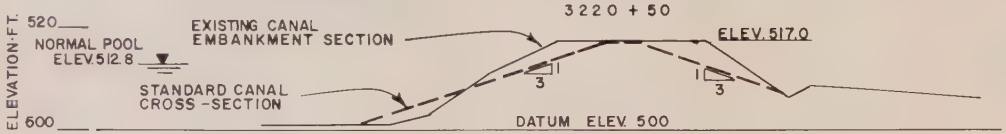
Canal C/L Station

3162+50 - 3167+50

Condition Classification
Class 2

Recommended Foundation Treatment

Widen embankment outboard to limits shown on section E-E



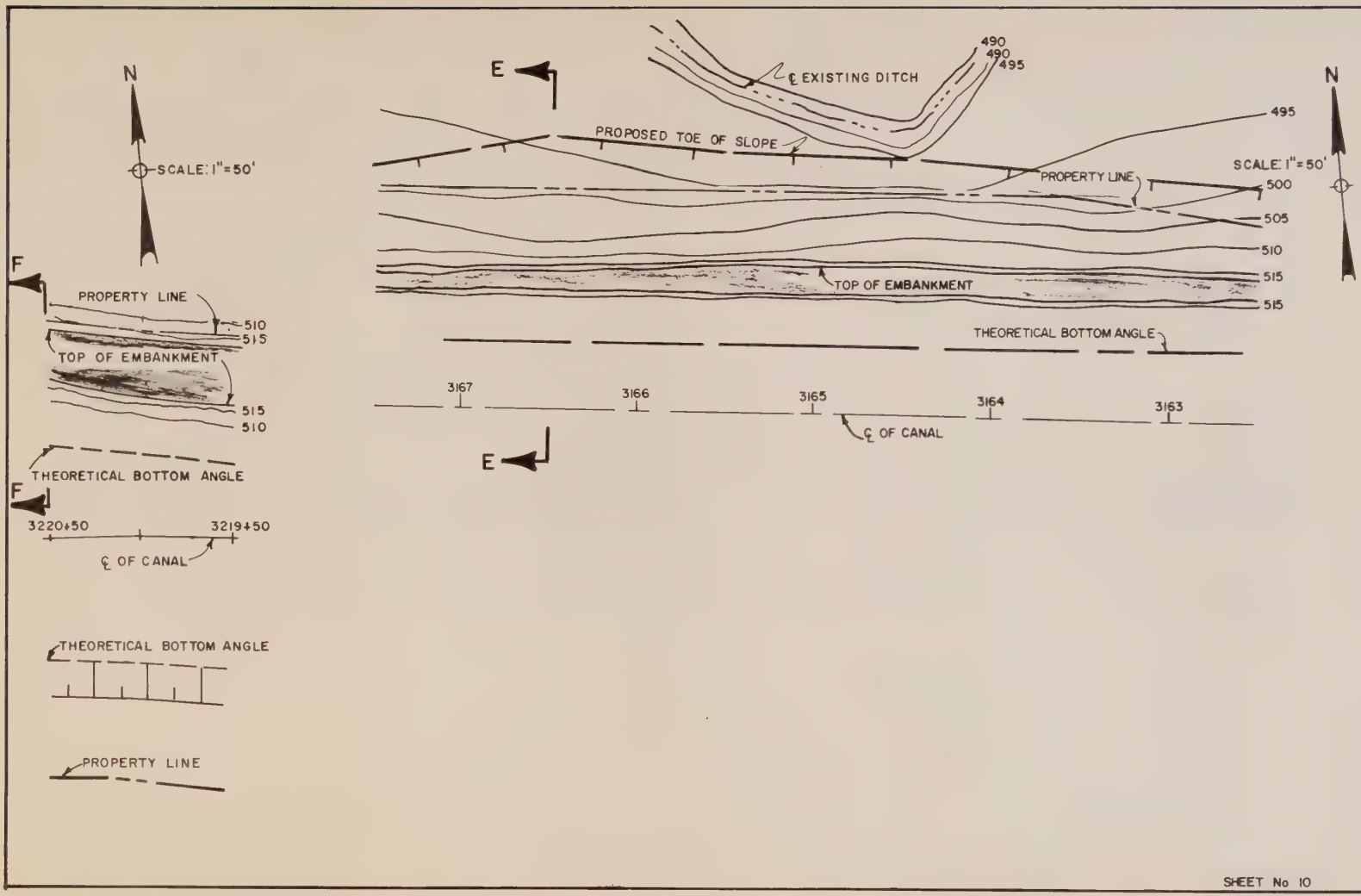
SECTION F-F
SCALE: 1"= 20'

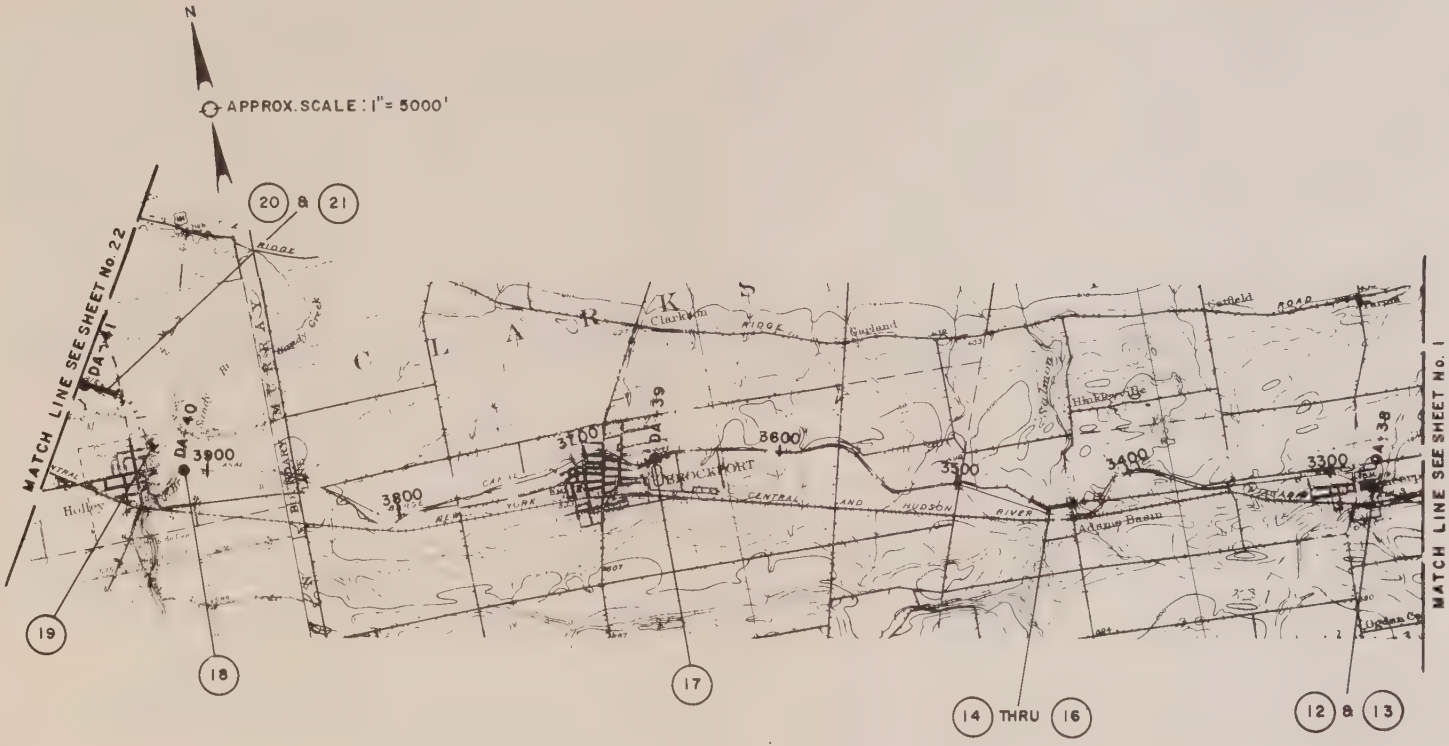
Canal C/L Station

3219+50 - 3220+50

Condition Classification
Class 4

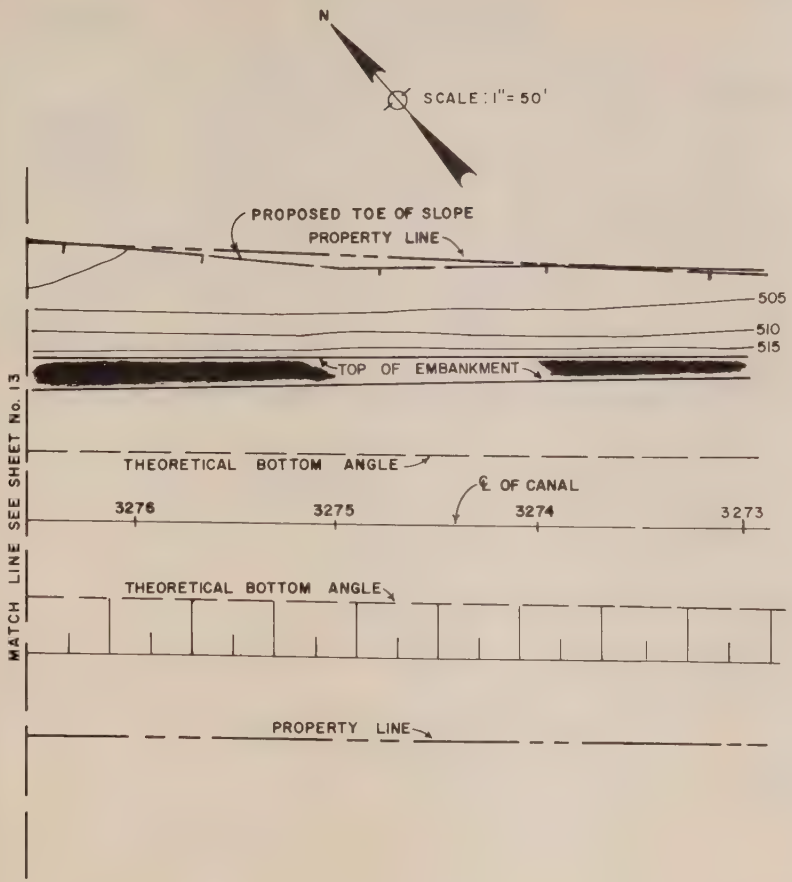
Recommended Foundation Treatment
None

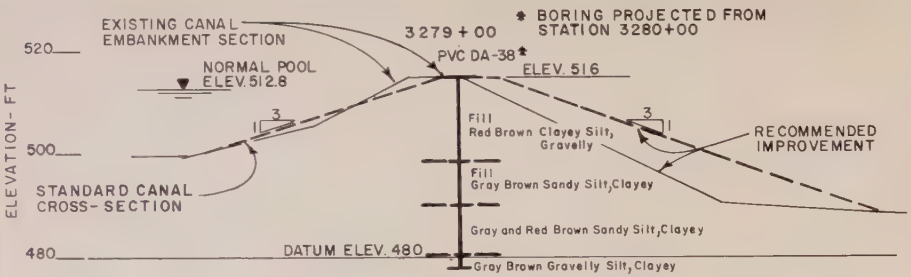

N
SCALE: 1"=50'
F
PROPERTY LINE
510
515
TOP OF EMBANKMENT
515
510
THEORETICAL BOTTOM ANGLE
F
3220+50
3219+50
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
E
490
490
495
℄ EXISTING DITCH
PROPOSED TOE OF SLOPE
495
PROPERTY LINE
500
505
510
515
TOP OF EMBANKMENT
515
THEORETICAL BOTTOM ANGLE
3167
3166
3165
3164
3163
℄ OF CANAL
E
N
SCALE: 1"=50'



○ – SHEET NUMBER OF 1" = 50' SCALE PLAN

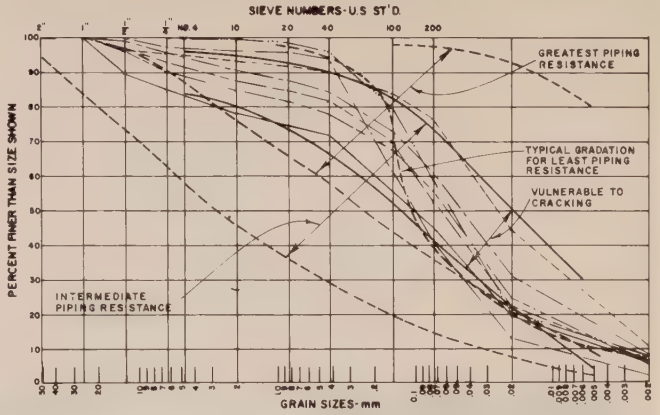
SHEET No. 11


N
SCALE: 1" = 50'
PROPOSED TOE OF SLOPE
PROPERTY LINE
505
510
515
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3276
3275
3274
3273
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 13

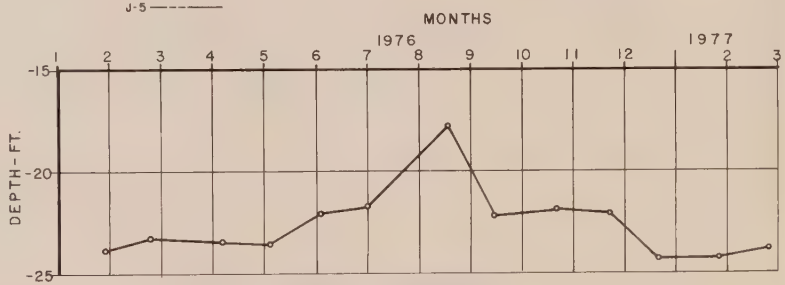


SECTION G-G

SCALE: 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-38



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-38

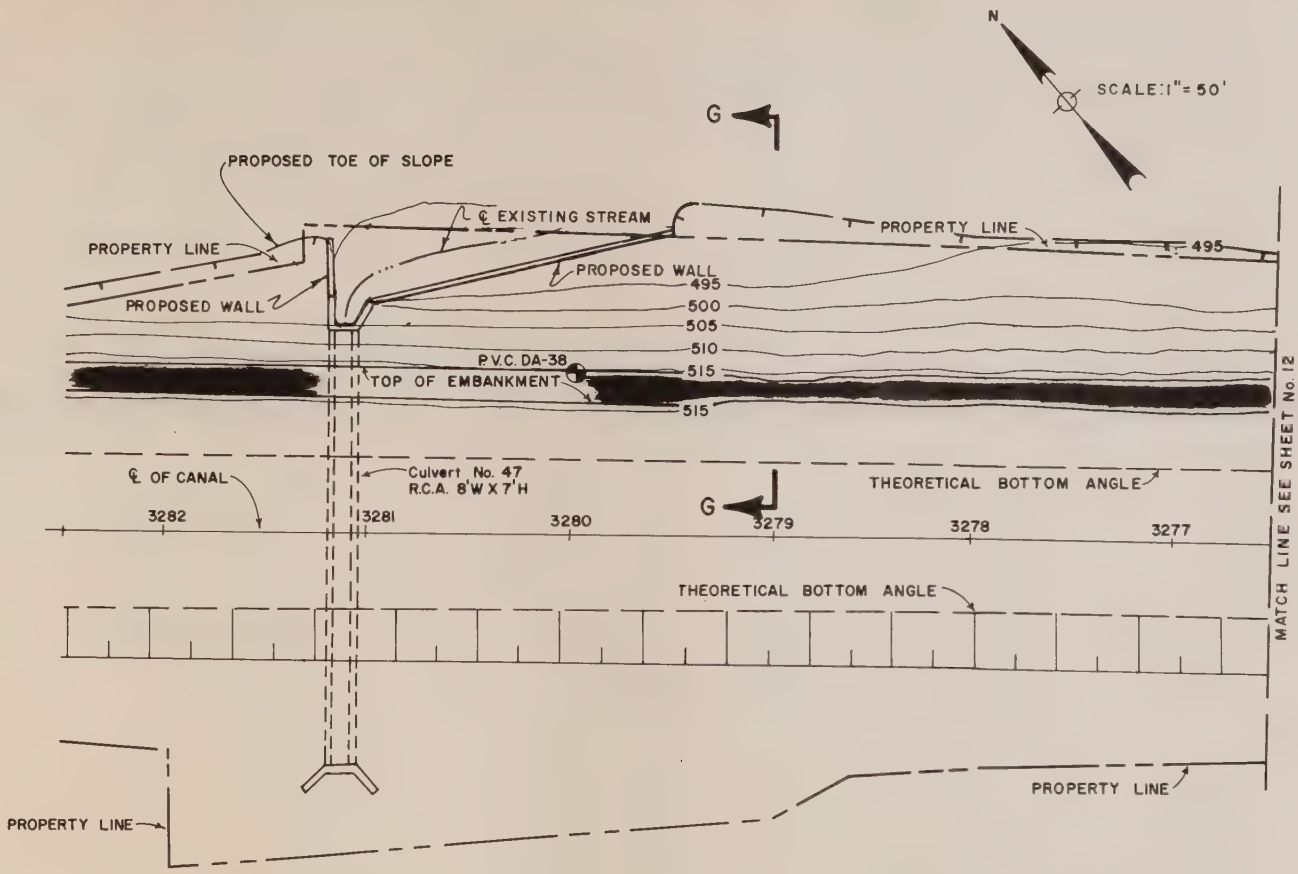
Canal C/L Station

3273+00 - 3282+50

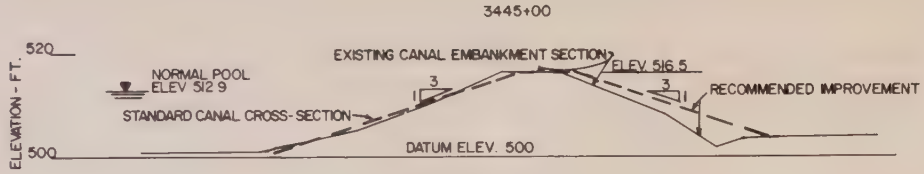
Condition Classification
Class 2

Recommended Foundation Treatment

3273+00-3279+50 3281+20-3282+50	Widen embankment outboard to criteria shown on section G-G and proposed toe of slope shown on sheets 12 and 13
3279+50-3281+20	Construct precast concrete crib wall south of existing stream to retain proposed embankment.
3281+20	Extend northwest wingwall as required.


N
SCALE: 1" = 50'
G
PROPOSED TOE OF SLOPE
℄ EXISTING STREAM
PROPERTY LINE
PROPERTY LINE
495
PROPOSED WALL
PROPOSED WALL
495
500
505
510
515
P.V.C. DA-38
TOP OF EMBANKMENT
515
℄ OF CANAL
Culvert No. 47
R.C.A. 8'W X 7'H
G
THEORETICAL BOTTOM ANGLE
3282
3281
3280
3279
3278
3277
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 12
PROPERTY LINE
PROPERTY LINE

SHEET No. 13



SECTION II-II

SCALE 1" = 20'

Canal C/L Stations

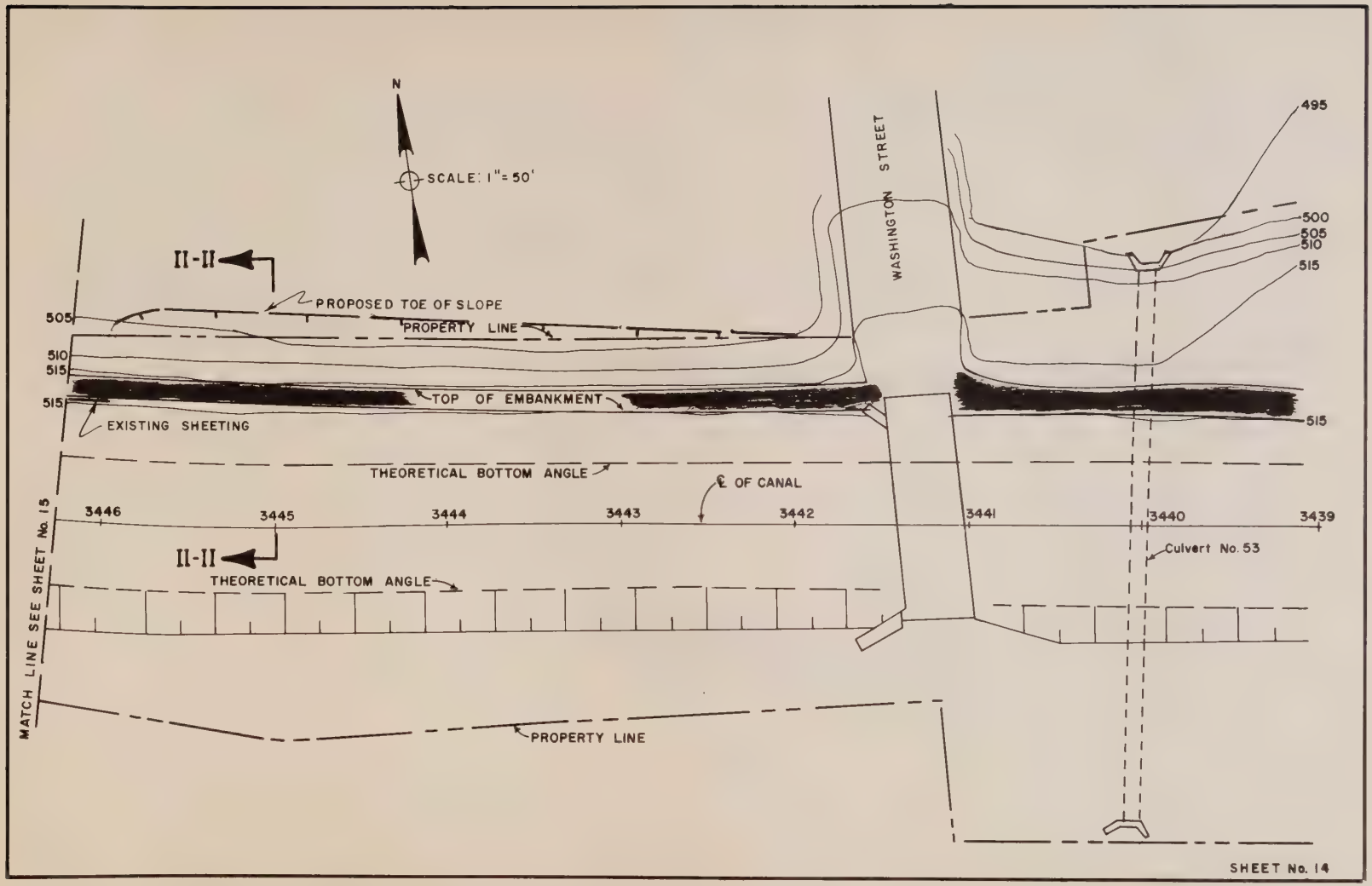
3442+00 - 3446+00

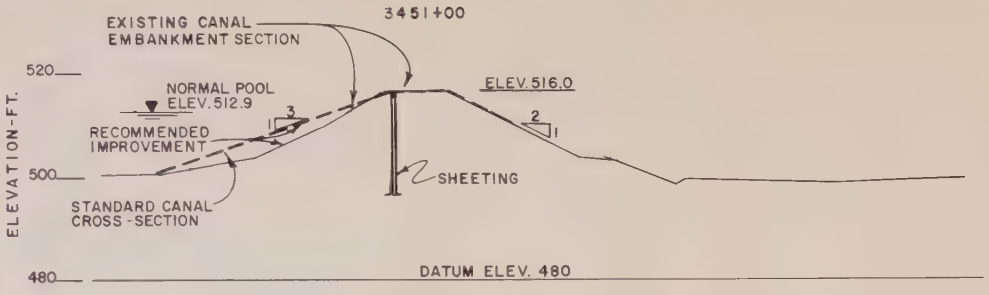
Condition Classification

Class 2

Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section II-II and proposed toe of slope limits shown on sheet 14


N
SCALE: 1"= 50'
II-II
PROPOSED TOE OF SLOPE
PROPERTY LINE
505
510
515
515
TOP OF EMBANKMENT
EXISTING SHEETING
WASHINGTON STREET
495
500
505
510
515
515
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
3446
3445
3444
3443
3442
3441
3440
3439
Culvert No. 53
II-II
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 15
PROPERTY LINE
SHEET No. 14



SECTION H-H

SCALE: 1" = 20'

Canal C/L Stations

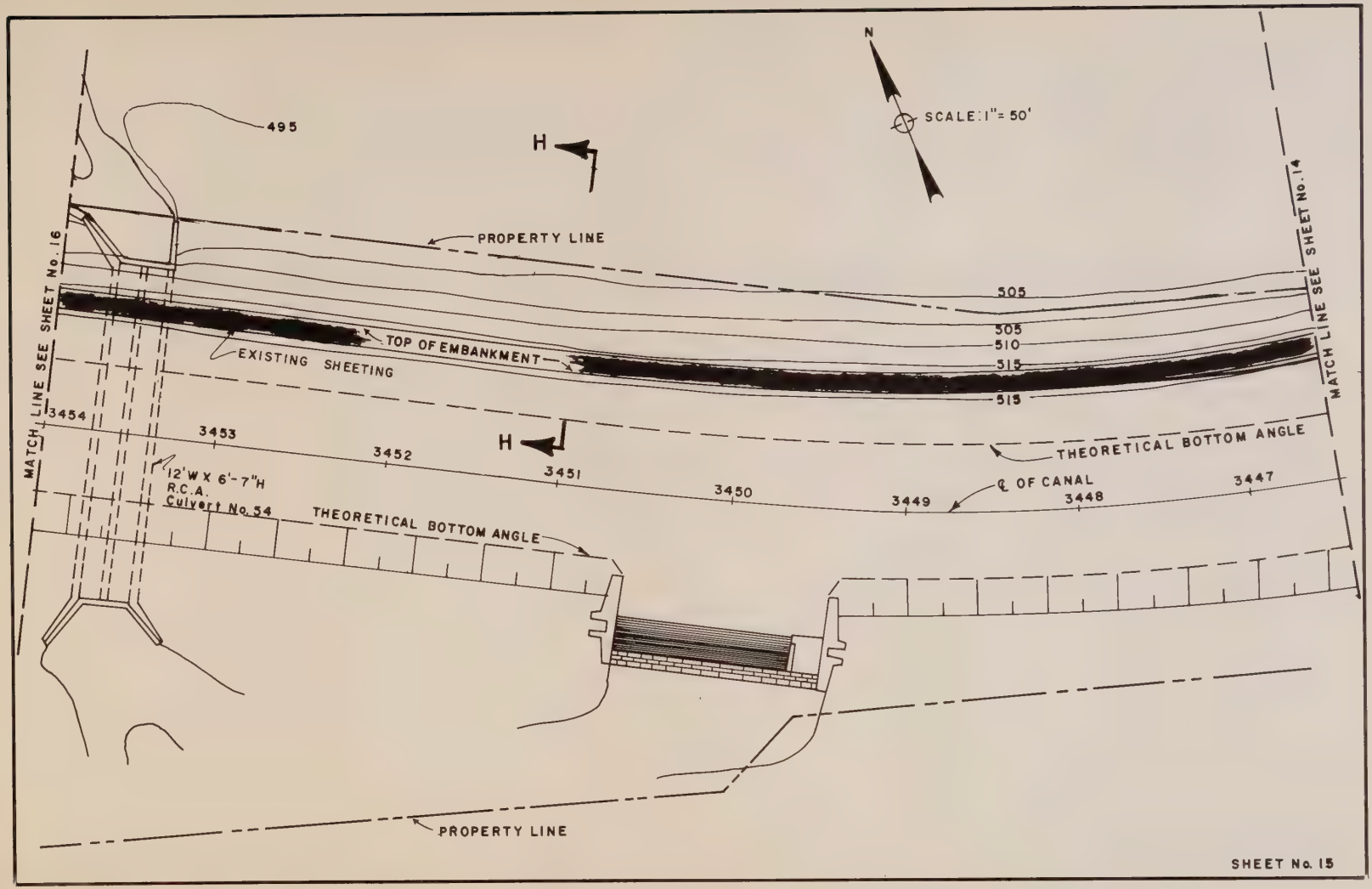
3446+00 - 3458+00

Condition Classification

Class 3

Recommended Foundation Treatment

Improve inboard bank protection as required. Periodic maintenance may be needed to repair minor inboard rip-rap sloughing.


N
SCALE: 1" = 50'
495
H
PROPERTY LINE
505
505
510
515
515
TOP OF EMBANKMENT
EXISTING SHEETING
MATCH LINE SEE SHEET No. 16
MATCH LINE SEE SHEET No. 14
3454
3453
3452
3451
3450
3449
3448
3447
H
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
12'W X 6'-7"H
R.C.A.
Culvert No. 54
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 15

SECTION I-I
SCALE 1" = 20'

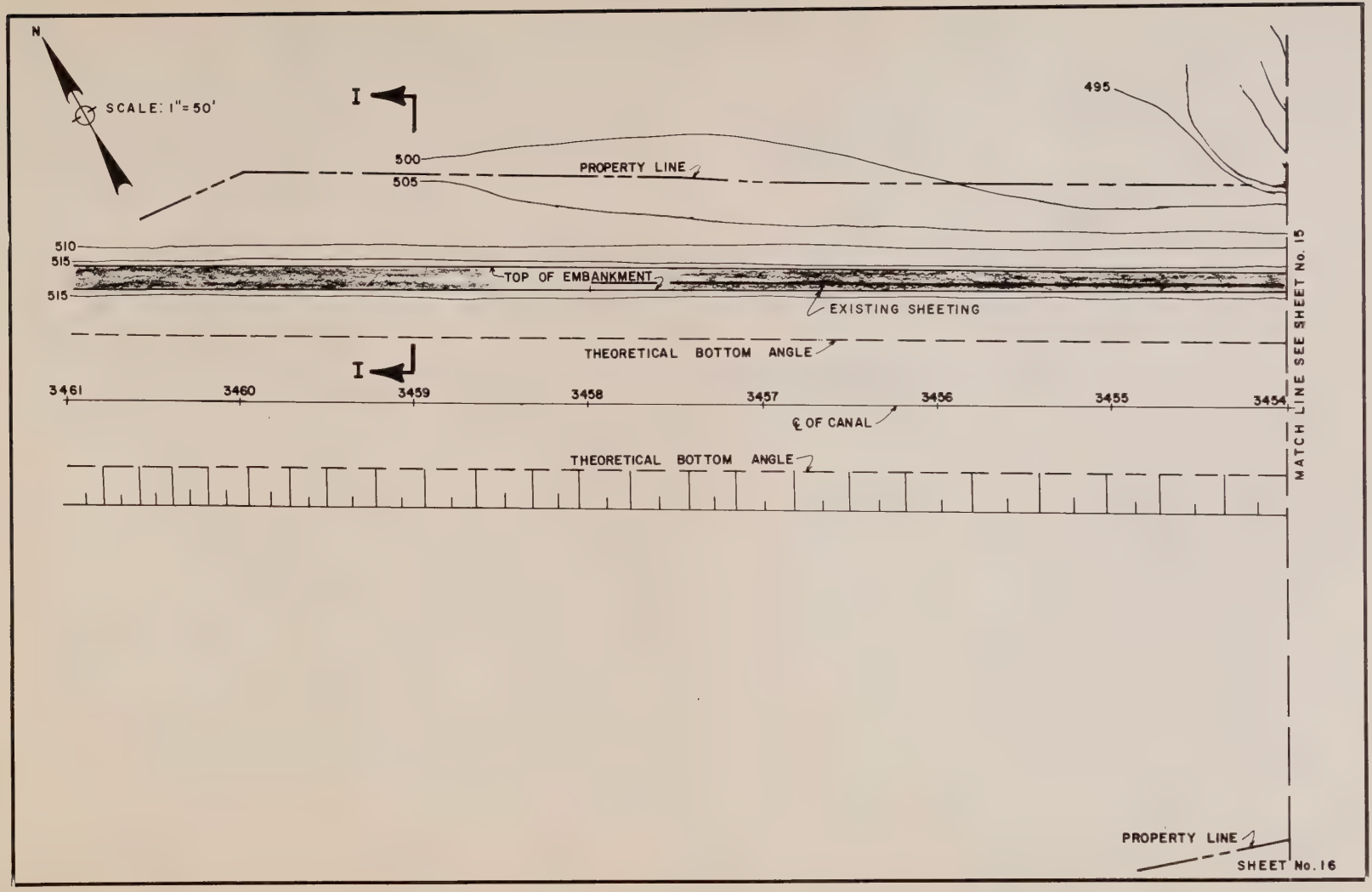
Canal C/L Stations

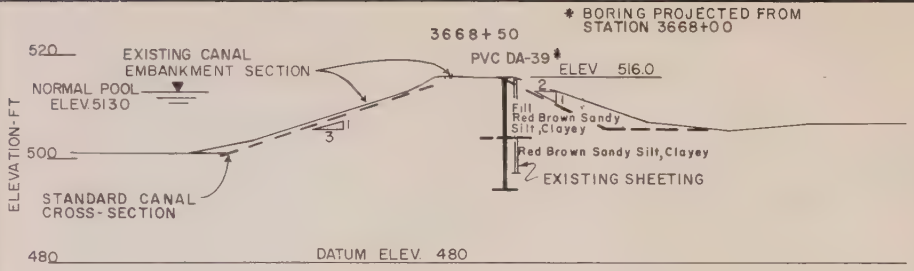
3458+00 - 3461+00

Condition Classification
Class 3

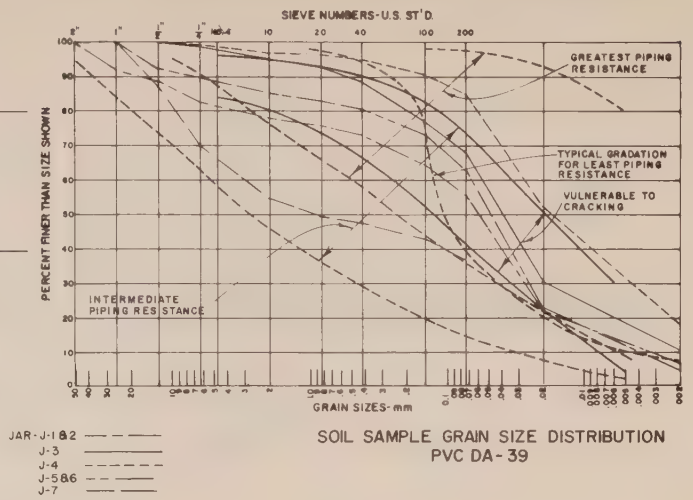
Recommended Foundation Treatment

Periodic maintenance may be needed to repair minor inboard rip-rap sloughing


N
SCALE: 1"=50'
I
I
500
505
PROPERTY LINE
495
510
515
515
TOP OF EMBANKMENT
EXISTING SHEETING
THEORETICAL BOTTOM ANGLE
3461
3460
3459
3458
3457
3456
3455
3454
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 15
PROPERTY LINE
SHEET No. 16



SECTION J-J
SCALE 1" = 20'



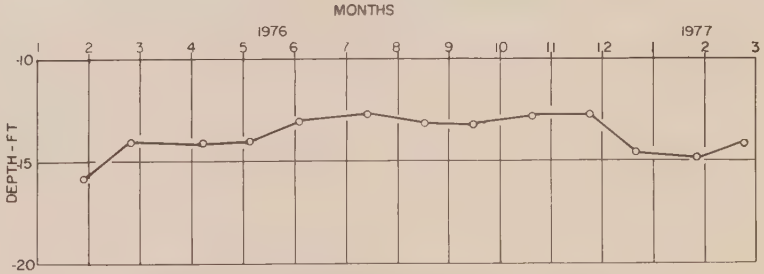
SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-39

Canal C/L Station

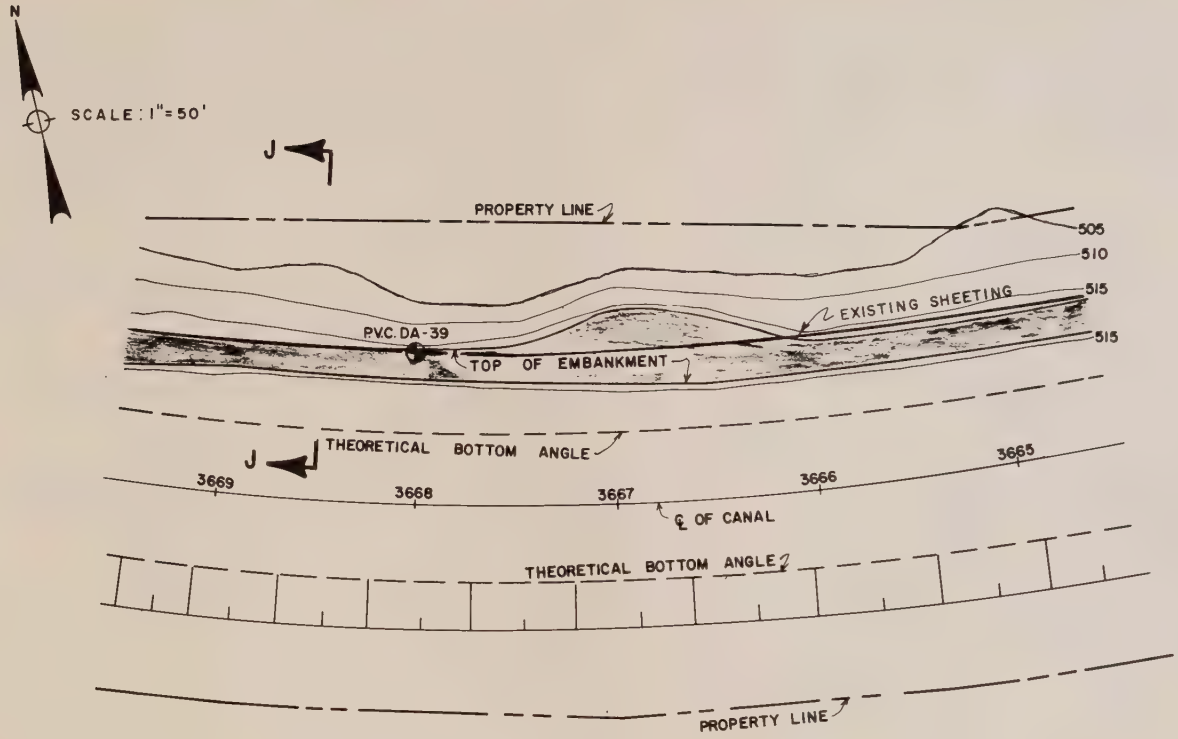
3664+50 - 3669+50

Condition Classification
Class 4

Recommended Foundation Treatment
none



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-39


N
SCALE: 1"=50'
J
PROPERTY LINE
505
510
515
EXISTING SHEETING
515
P.V.C. DA-39
TOP OF EMBANKMENT
J
THEORETICAL BOTTOM ANGLE
3669
3668
3667
3666
3665
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

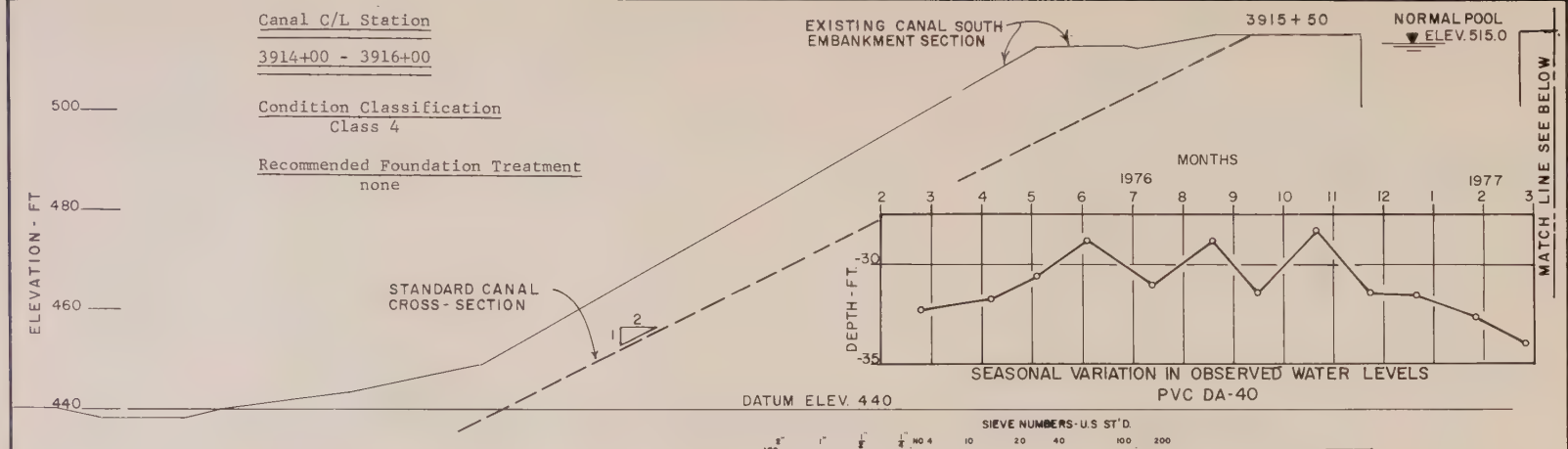
SHEET No. 17

Canal C/L Station

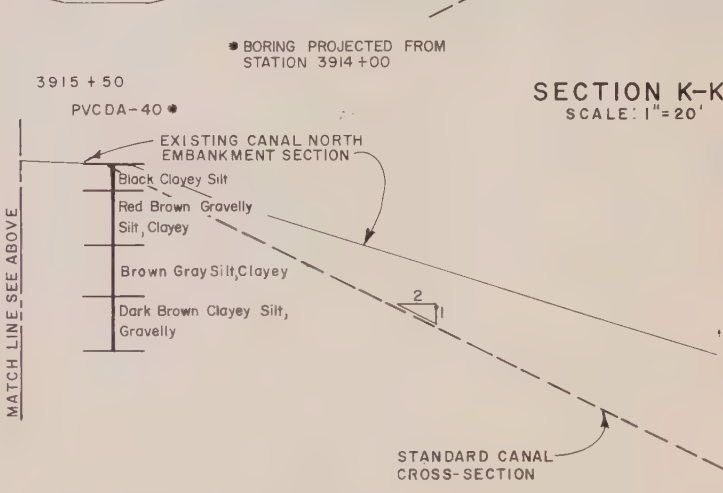
3914+00 - 3916+00

Condition Classification
Class 4

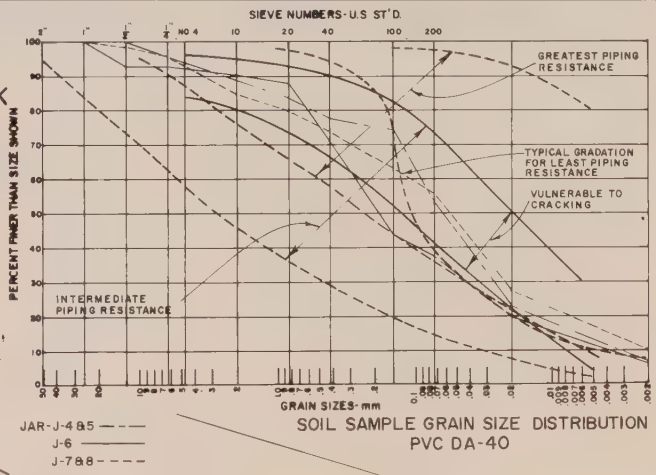
Recommended Foundation Treatment
none



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-40

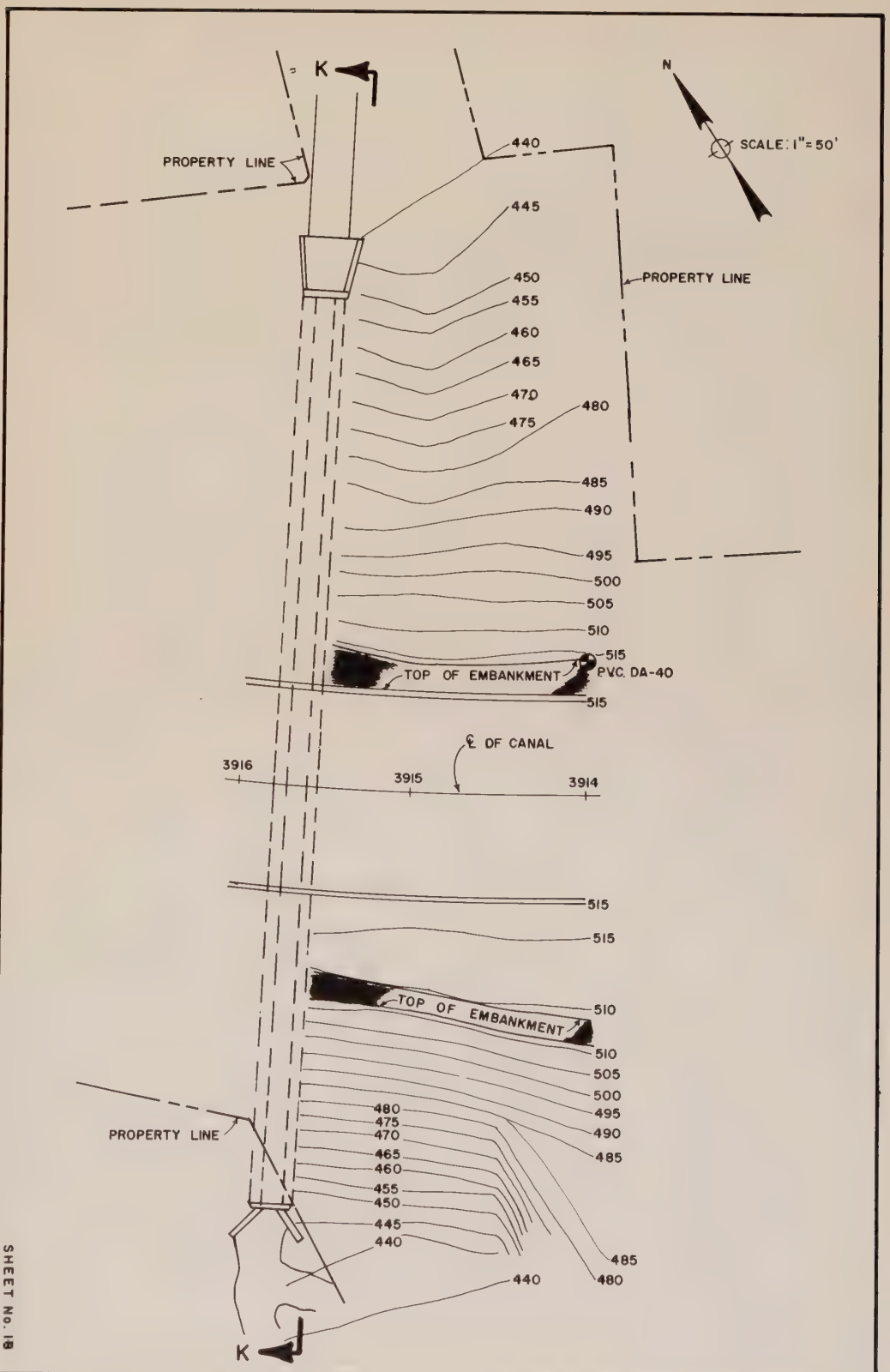


SECTION K-K
SCALE: 1"=20'

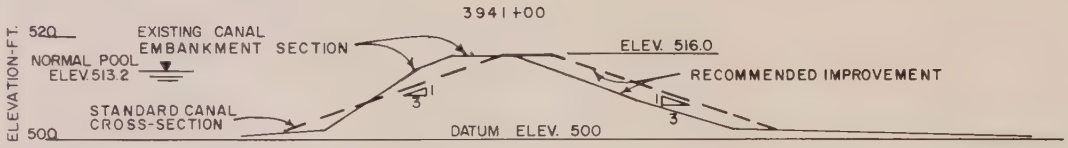


SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-40

SHEET No 18-1


K
N
SCALE: 1"=50'
PROPERTY LINE
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
TOP OF EMBANKMENT
PVC. DA-40
℄ OF CANAL
3916
3915
3914
PROPERTY LINE
K

SHEET No. 18



SECTION L-L
SCALE 1" = 20'

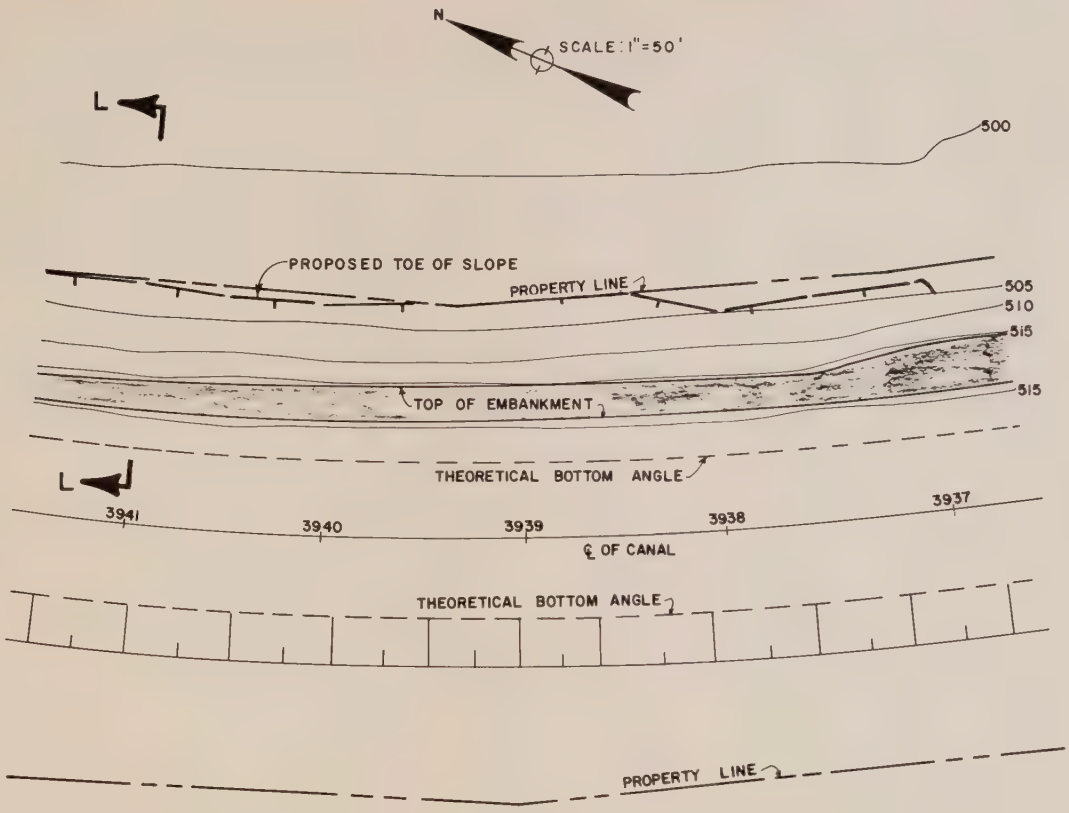
Canal C/L Stations

3937+00 - 3941+50

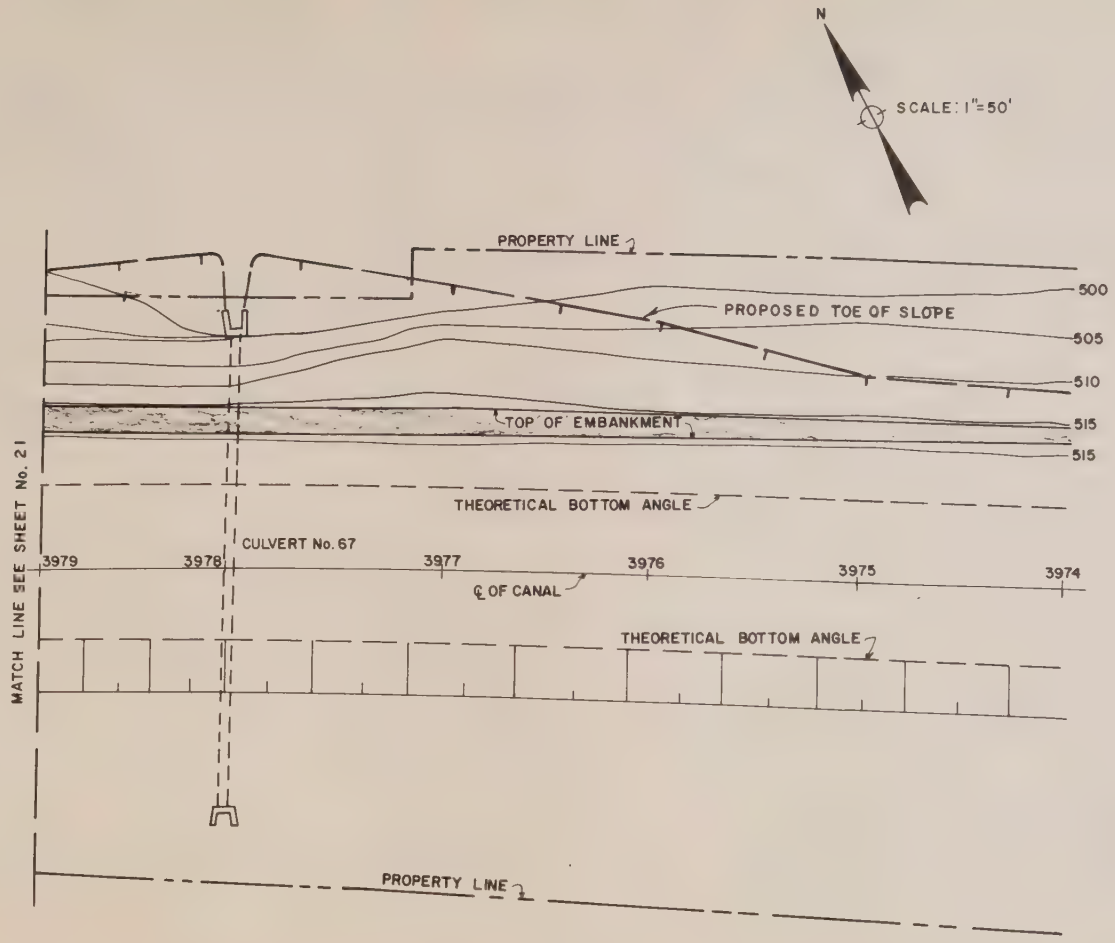
Condition Classification
Class 3

Recommended Foundation Treatment

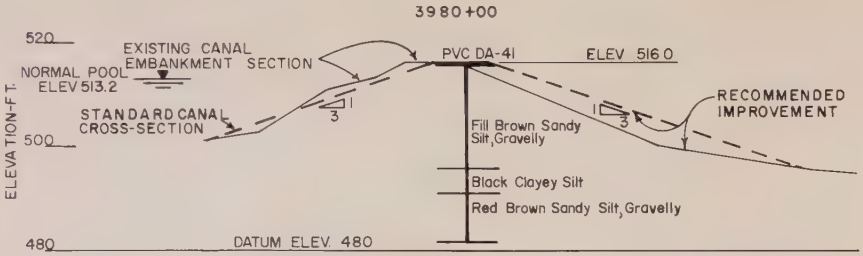
Widen embankment outboard to criteria shown on section L-L and proposed toe of slope on sheet 19


N
SCALE: 1"=50'
L
500
PROPOSED TOE OF SLOPE
PROPERTY LINE
505
510
515
TOP OF EMBANKMENT
515
L
THEORETICAL BOTTOM ANGLE
3941
3940
3939
3938
3937
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

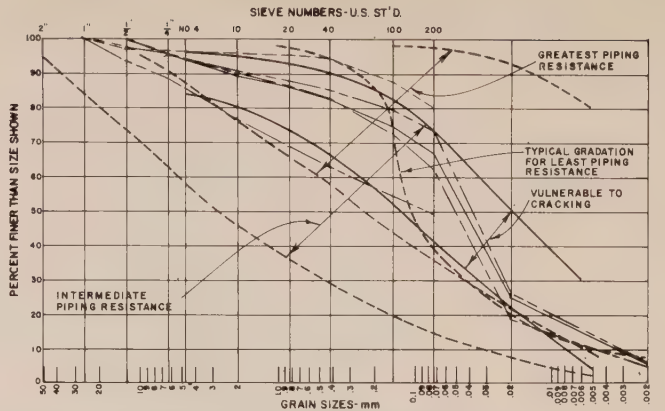
SHEET No. 19


N
SCALE: 1"=50'
PROPERTY LINE
PROPOSED TOE OF SLOPE
500
505
510
TOP OF EMBANKMENT
515
515
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 21
CULVERT No. 67
3979
3978
3977
3976
3975
3974
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

SHEET No 20



SECTION M-M
SCALE 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-41

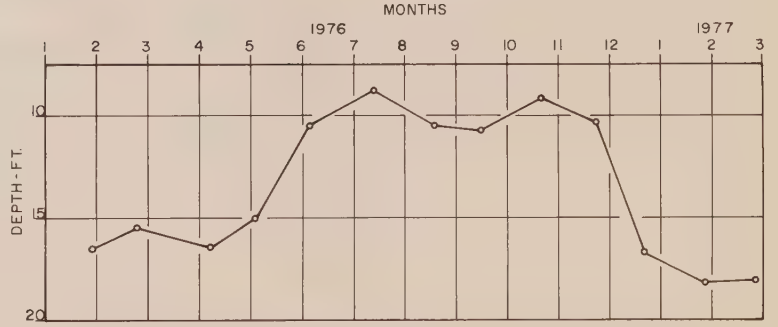
Canal C/L Station

3974+00 - 3981+00

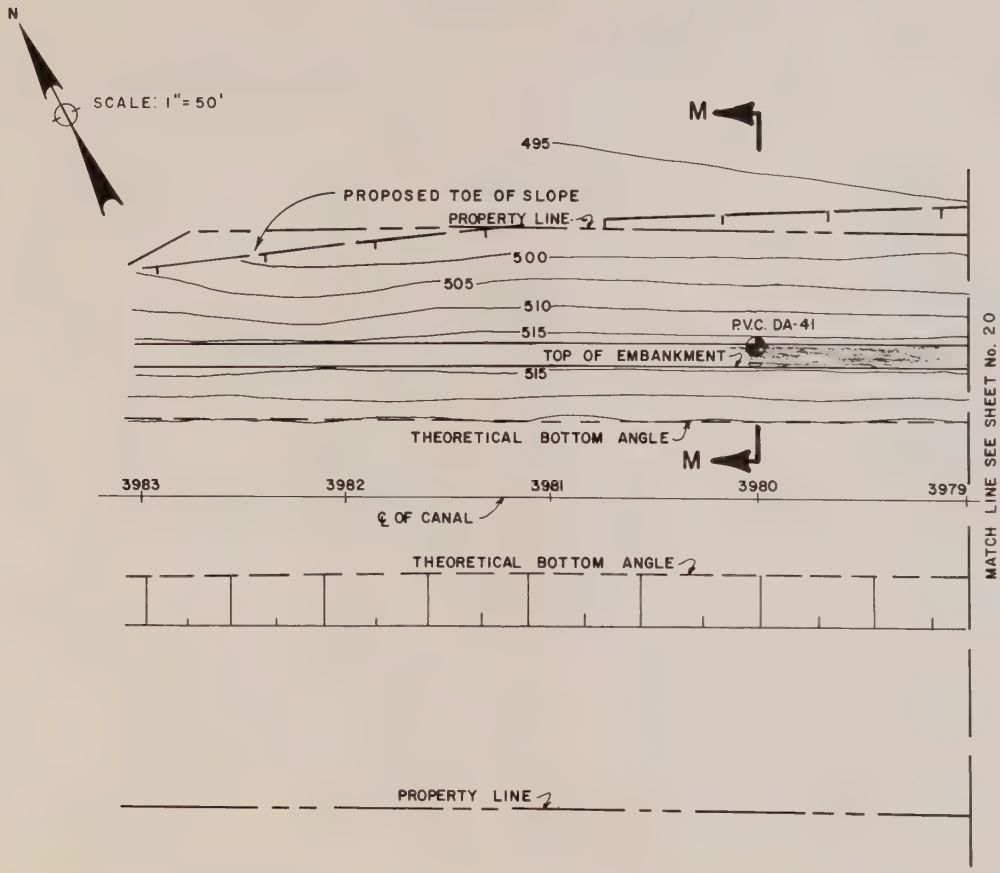
Condition Classification
Class 2

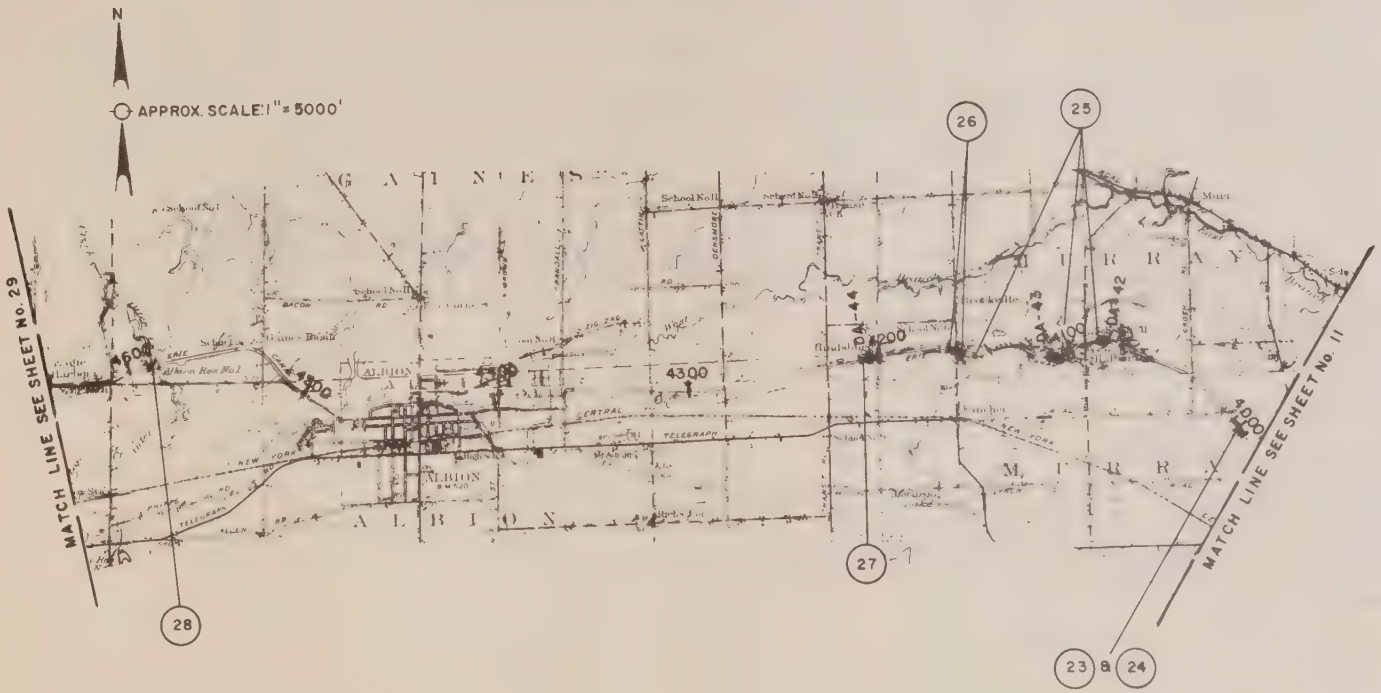
Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section MM and proposed toe of slope on sheets 20-21. Extend culvert 67 to limits of embankment.



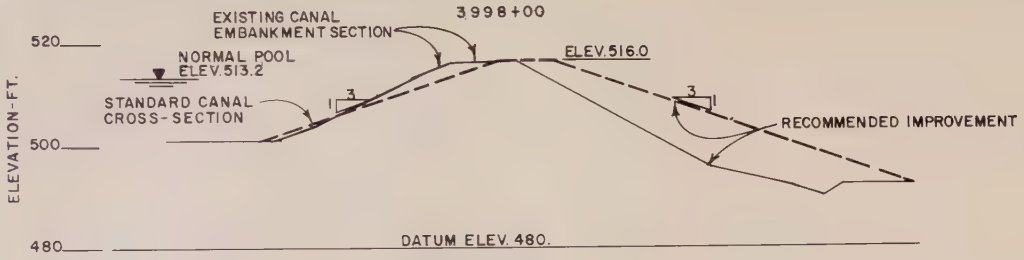
SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-41


N
SCALE: 1"= 50'
M
495
PROPOSED TOE OF SLOPE
PROPERTY LINE
500
505
510
515
P.V.C. DA-41
TOP OF EMBANKMENT
515
THEORETICAL BOTTOM ANGLE
M
3983
3982
3981
3980
3979
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 20
PROPERTY LINE



○ - SHEET NUMBER OF 1" = 50' SCALE PLAN

SHEET No. 22



SECTION N-N

SCALE: 1"=20'

Canal C/L Station

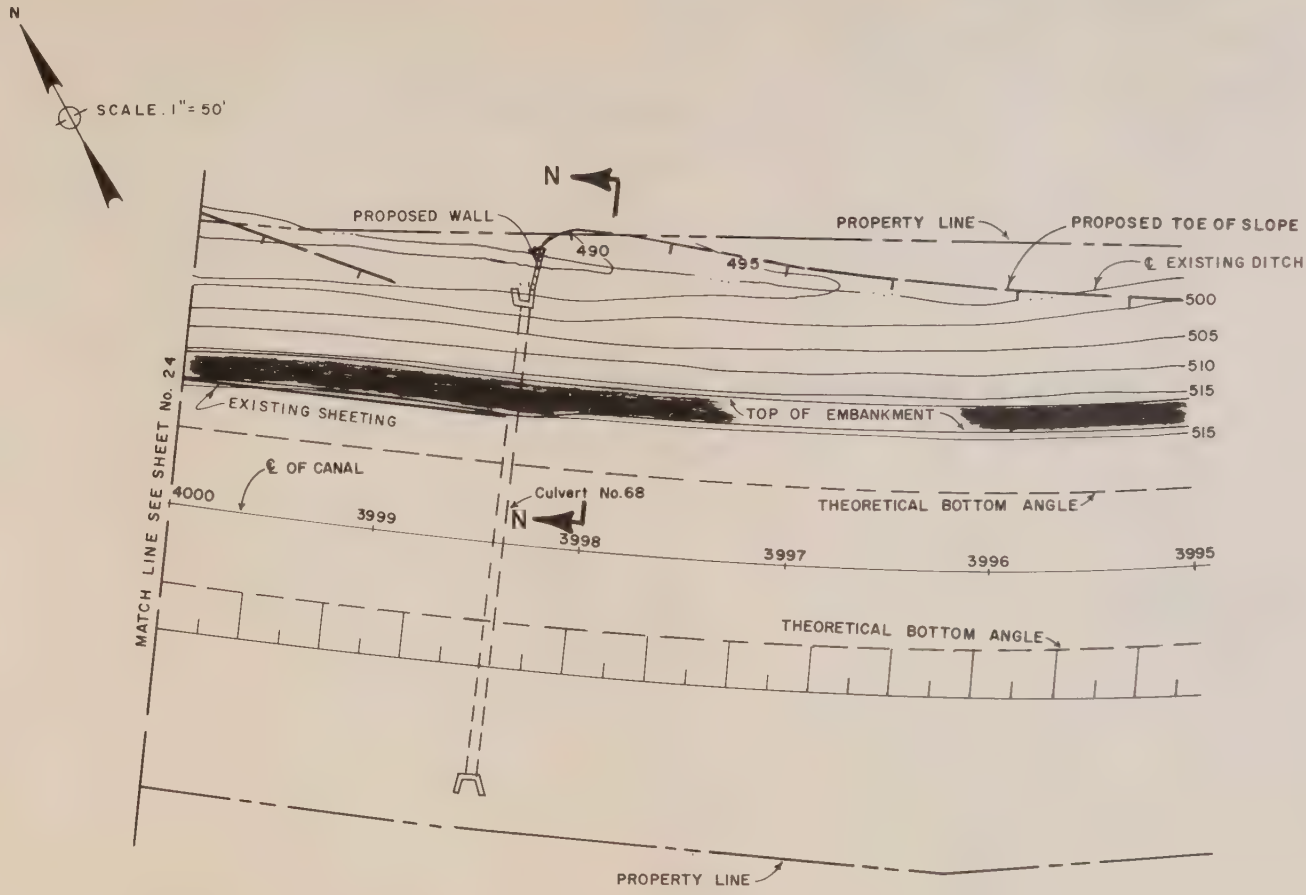
3995+00 - 4005+00

Condition Classification

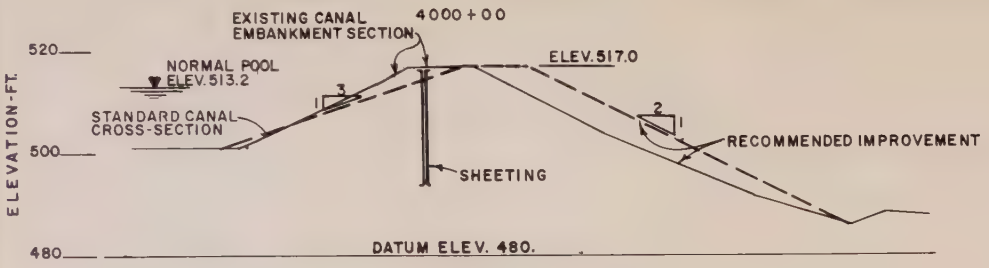
Class 2

Recommended Foundation Treatment

3995+00 - 3998+48 4000+48 - 4005+00	Widen embankment outboard to criteria shown on section N-N and end slope limits shown on sheets 23-24.
3999+00 - 4000+48	Widen embankment outboard to criteria shown on section O-O and end slope limits shown on sheets 23-24.
3998+48 - 3999+00	None
3998+40±	Extend east wingwall to end limit of fill.


N
SCALE. 1" = 50'
N
PROPOSED WALL
490
495
PROPERTY LINE
PROPOSED TOE OF SLOPE
℄ EXISTING DITCH
500
505
510
515
515
EXISTING SHEETING
TOP OF EMBANKMENT
MATCH LINE SEE SHEET No. 24
℄ OF CANAL
4000
3999
Culvert No.68
N
3998
3997
3996
3995
THEORETICAL BOTTOM ANGLE
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

SHEET No. 23



SECTION O-O

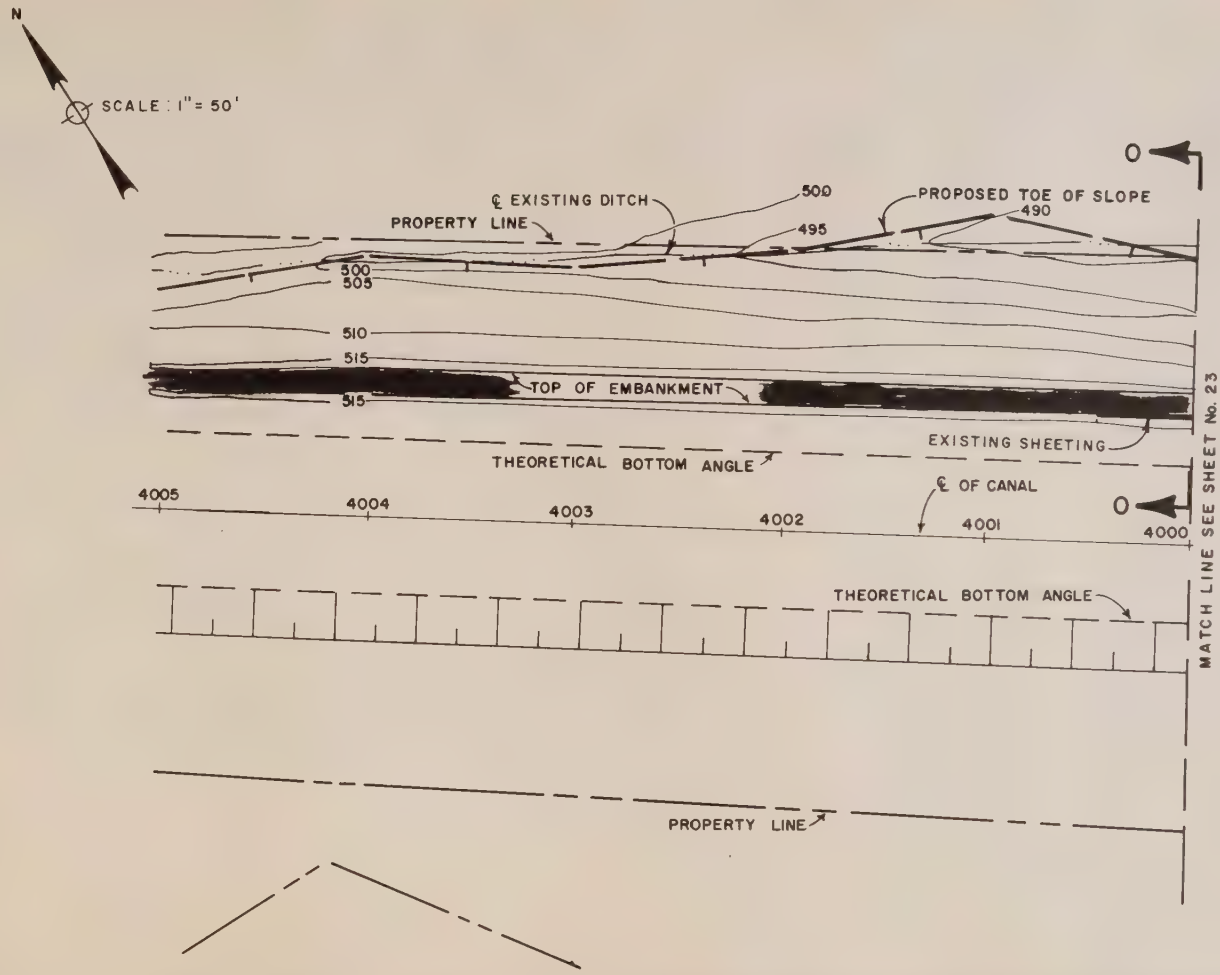
SCALE: 1"= 20'

Canal C/L Station

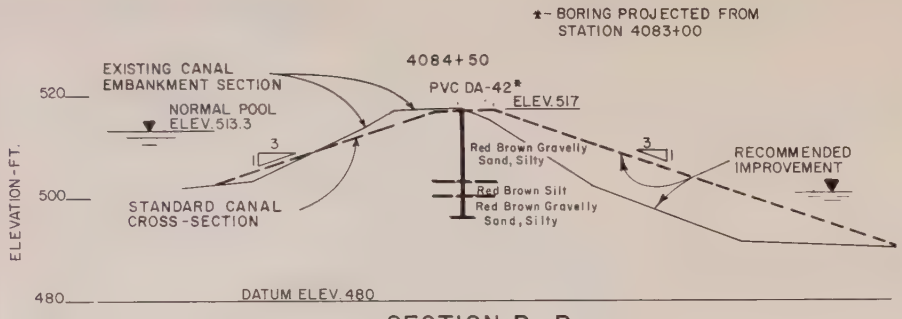
3995+00 - 4005+00

See Sheet 23-1 for foundation treatment

SHEET No. 24-1

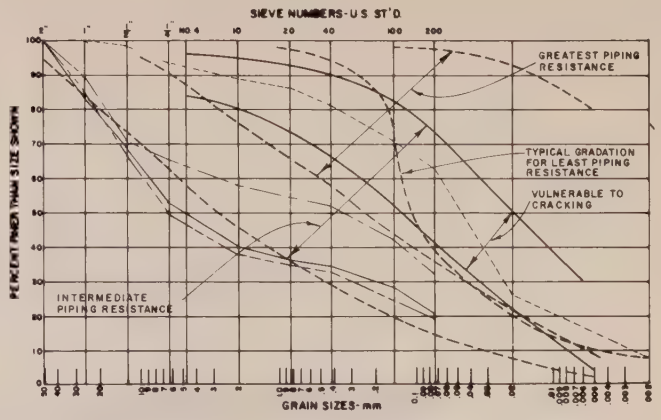

N
SCALE : 1" = 50'
℄ EXISTING DITCH
PROPERTY LINE
500
495
PROPOSED TOE OF SLOPE
490
500
505
510
515
515
TOP OF EMBANKMENT
EXISTING SHEETING
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
4005
4004
4003
4002
4001
4000
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 23

SHEET No. 24

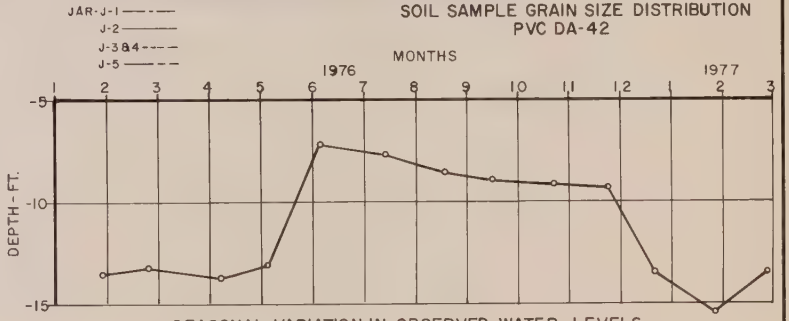


SECTION P-P

SCALE: 1"=20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-42



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-42

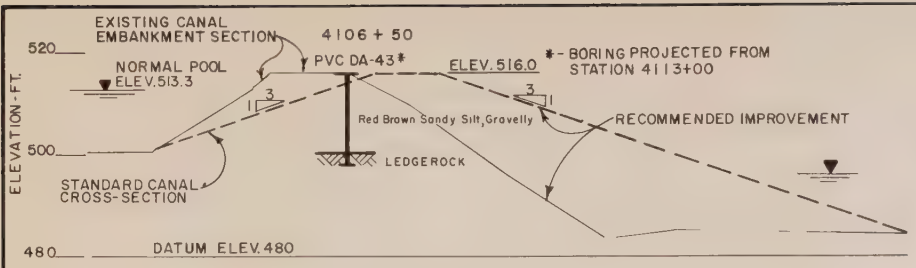
Canal C/L Station

4084+00 - 4085+50

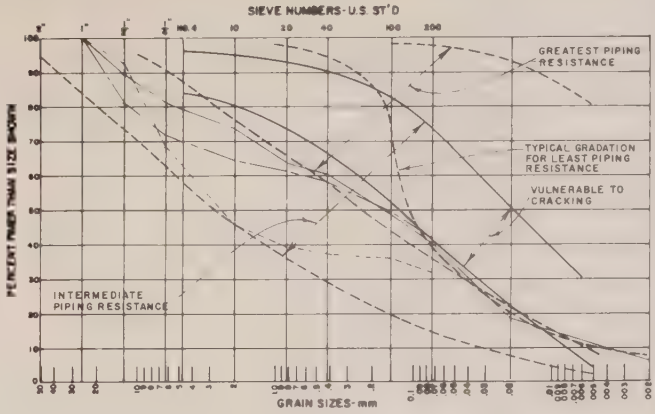
Condition Classification
Class 1

Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section P-P and end slope limits shown on sheet 25.



SECTION Q-Q
SCALE: 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-43

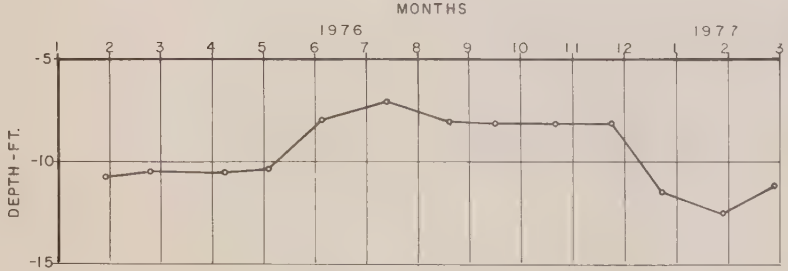
Canal C/L Station

4103+00 - 4107+00

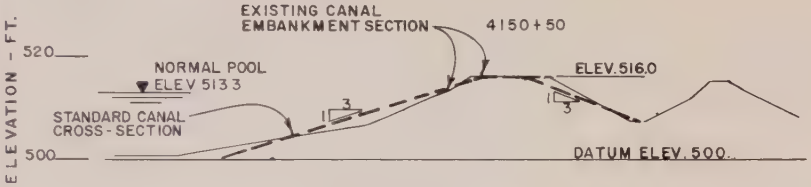
Condition Classification
Class 1

Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-43



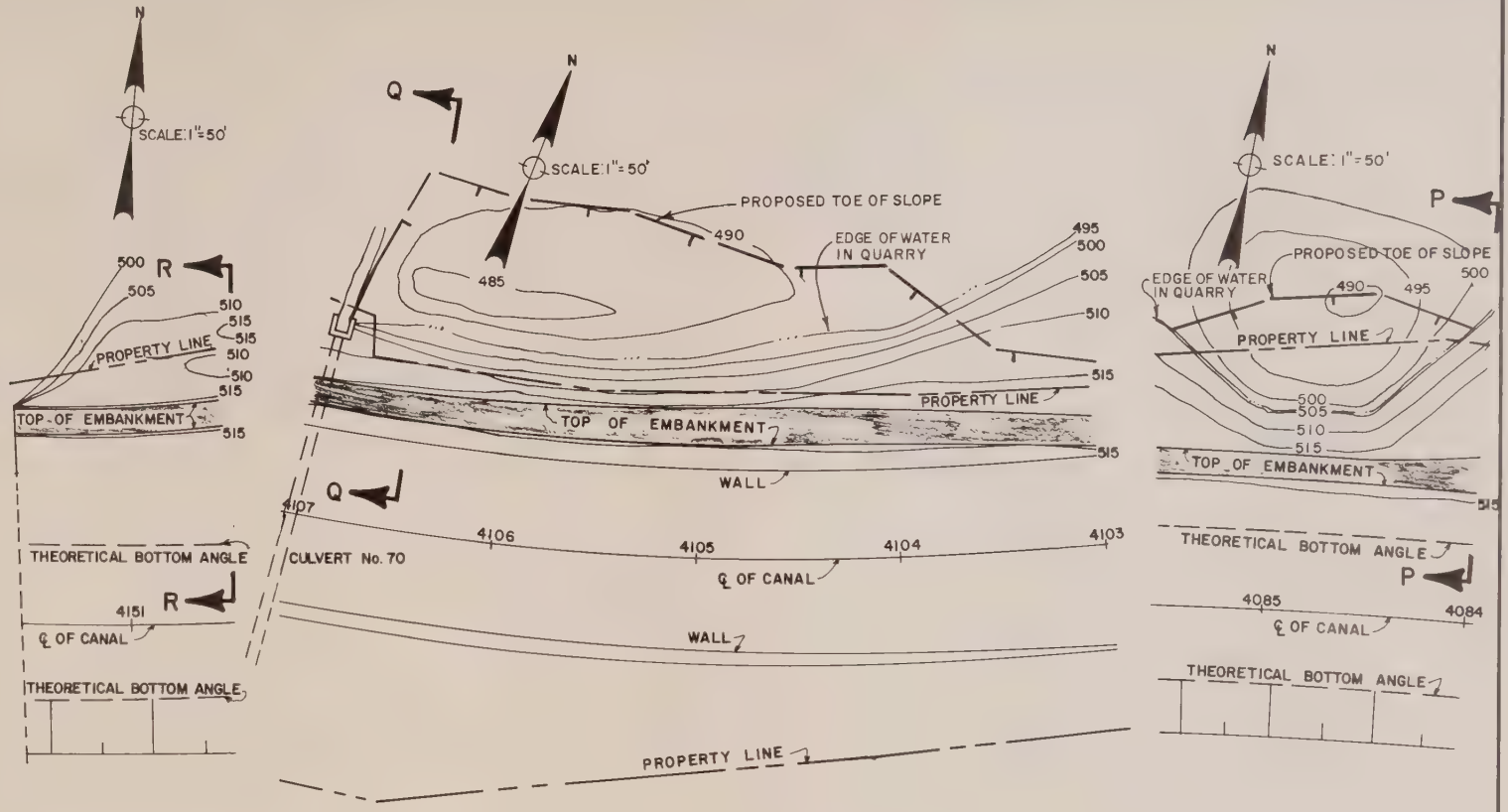
SECTION R-R
SCALE: 1"=20'

Canal C/L Station

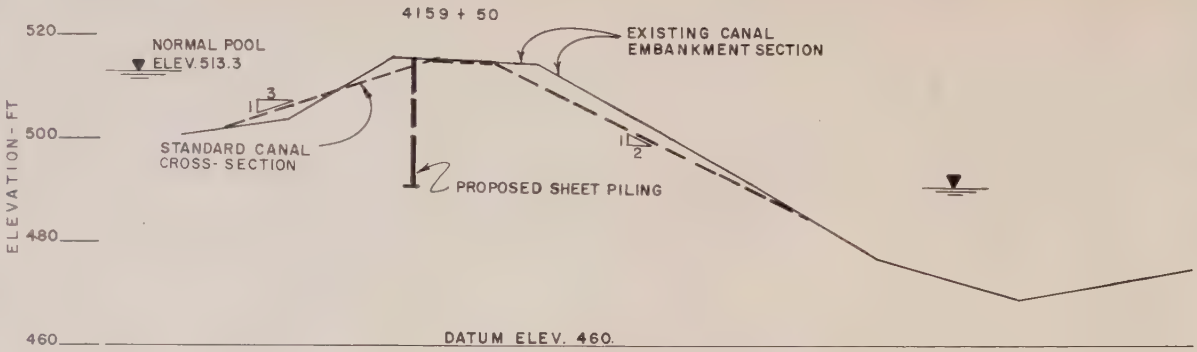
4150+50 - 4151+50

Condition Classification
Class 4

Recommended Foundation Treatment
None


N
SCALE: 1"=50'
500
505
510
515
R
PROPERTY LINE
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
4151
℄ OF CANAL
Q
PROPOSED TOE OF SLOPE
490
485
EDGE OF WATER IN QUARRY
495
WALL
4107
4106
4105
4104
4103
CULVERT No. 70
P
4085
4084
PROPERTY LINE

SHEET No. 25



SECTION S-S
SCALE: 1" = 20'

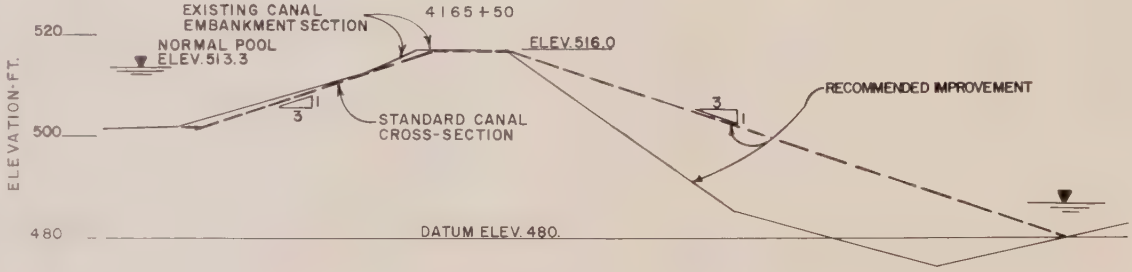
Canal C/L Station

4157+00 - 4161+00

Condition Classification
Class 2

Recommended Foundation Treatment

4157+50 - 4160+50 Drive steel sheeting to 25' below top of canal embankment or to refusal whichever is less.



SECTION T-T
SCALE: 1" = 20'

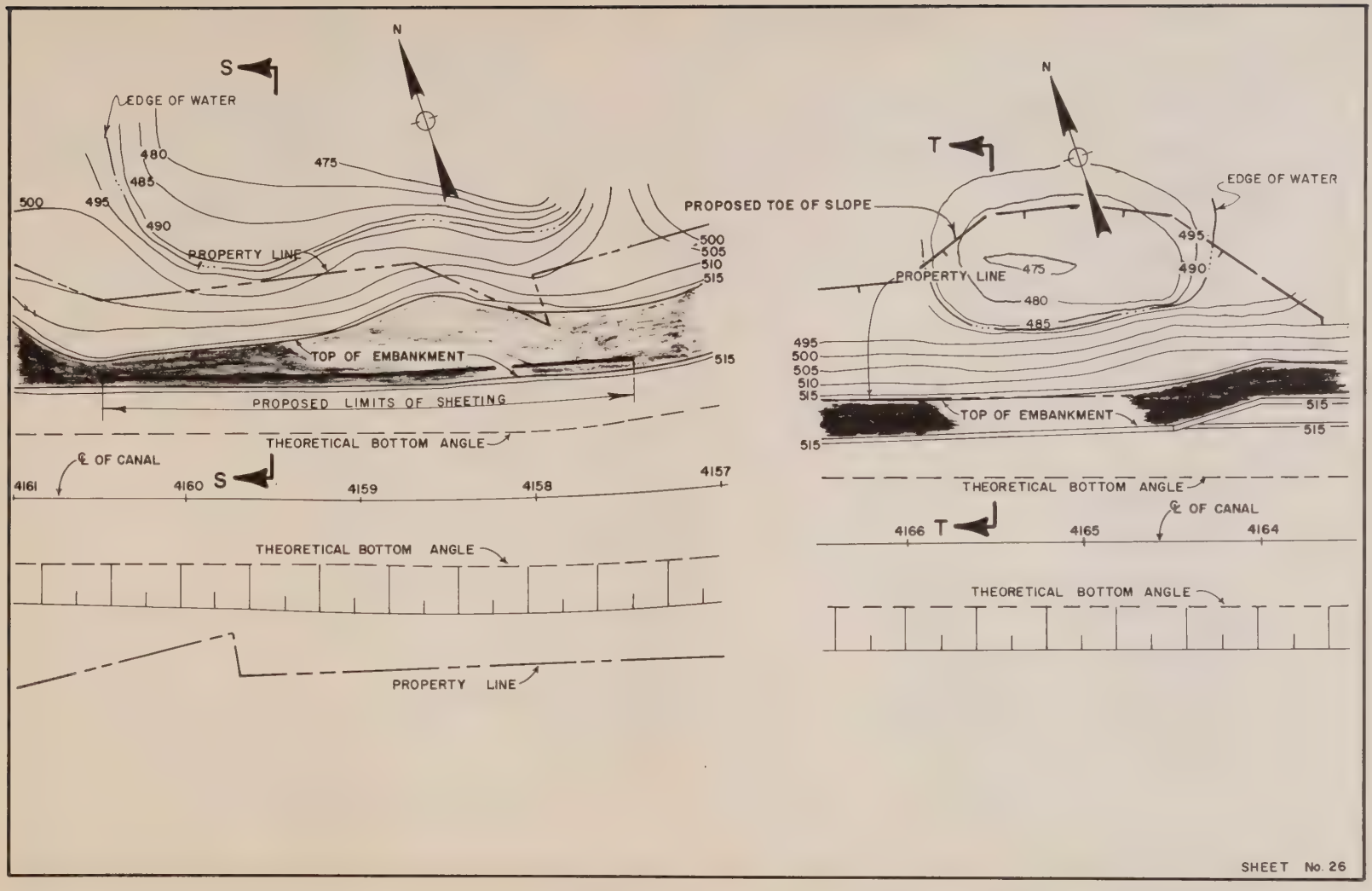
Canal C/L Station

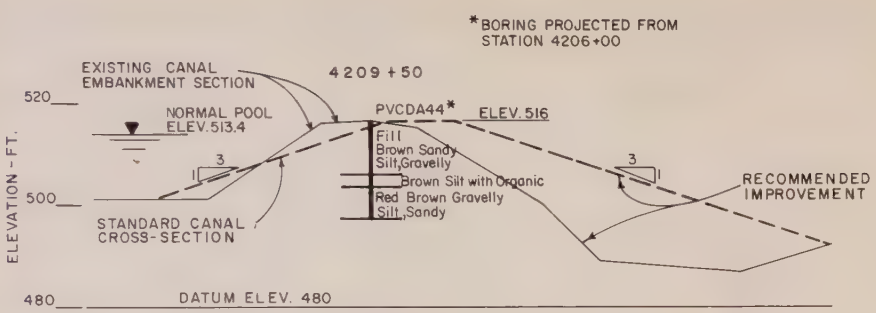
4163+75 - 4166+50

Condition Classification
Class 2

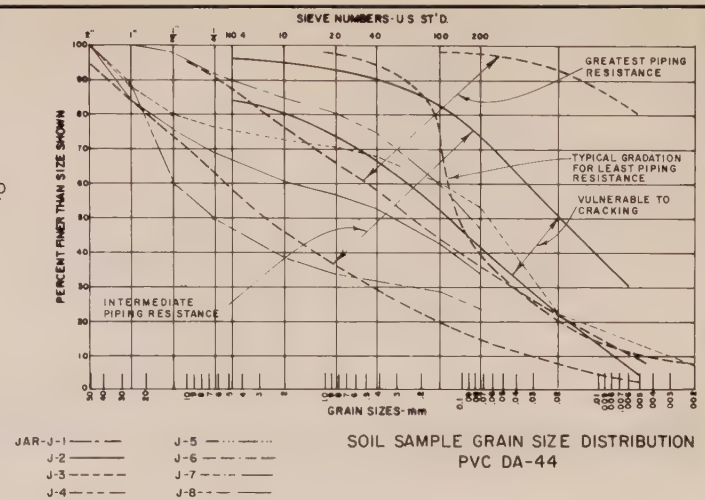
Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section T-T and end slope limit shown on sheet 26.


N
S
EDGE OF WATER
480
485
475
500
495
490
PROPERTY LINE
500
505
510
515
TOP OF EMBANKMENT
515
PROPOSED LIMITS OF SHEETING
THEORETICAL BOTTOM ANGLE
℄ OF CANAL
4161
4160
S
4159
4158
4157
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
N
T
EDGE OF WATER
PROPOSED TOE OF SLOPE
495
PROPERTY LINE
475
490
480
485
495
500
505
510
515
TOP OF EMBANKMENT
515
515
515
THEORETICAL BOTTOM ANGLE
4166
T
4165
℄ OF CANAL
4164
THEORETICAL BOTTOM ANGLE



SECTION U-U
SCALE: 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-44

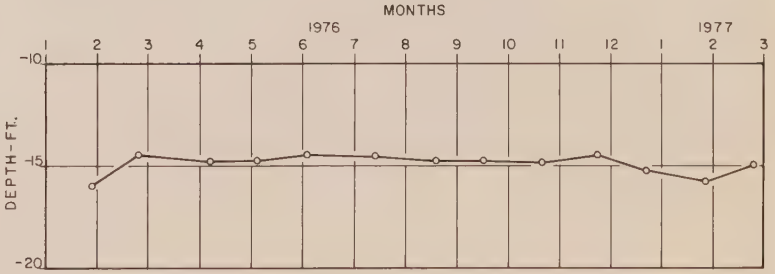
Canal C/L Stations

4205+50 - 4211+00

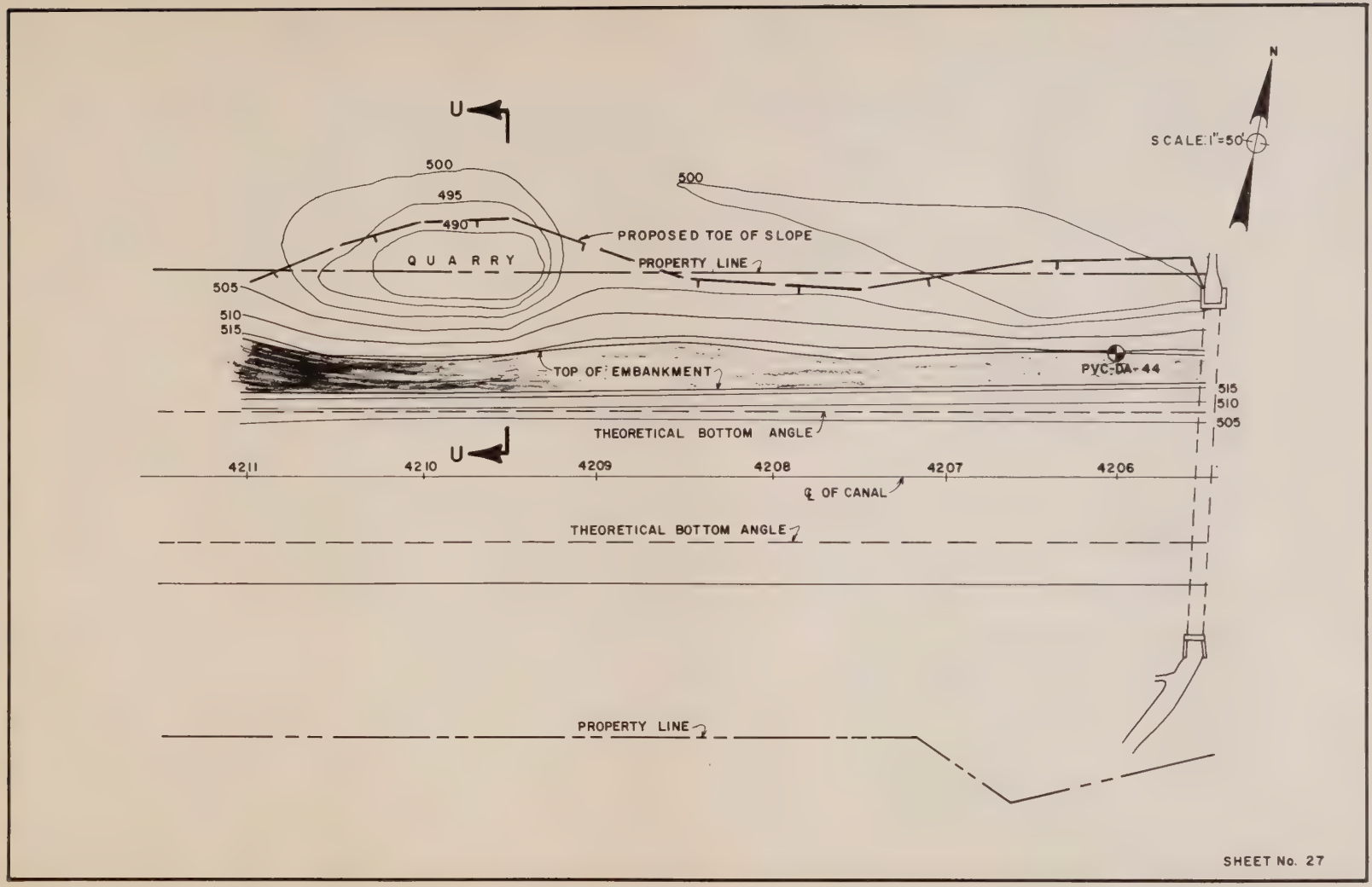
Condition Classification
Class 2

Recommended Foundation Treatment

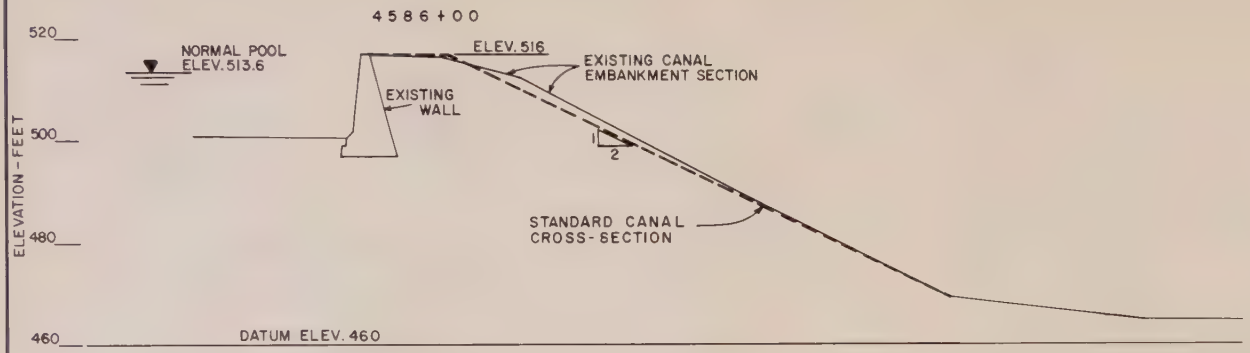
Widen embankment outboard to criteria shown on Section U-U and proposed toe of slope limits shown on sheet 27.



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-44


N
SCALE: 1"=50'
U
500
495
490
QUARRY
PROPOSED TOE OF SLOPE
PROPERTY LINE
500
505
510
515
TOP OF EMBANKMENT
PVC-DA-44
515
510
505
THEORETICAL BOTTOM ANGLE
U
4211
4210
4209
4208
4207
4206
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

SHEET No. 27



SECTION V-V

SCALE: 1" = 20'

Canal C/L Station

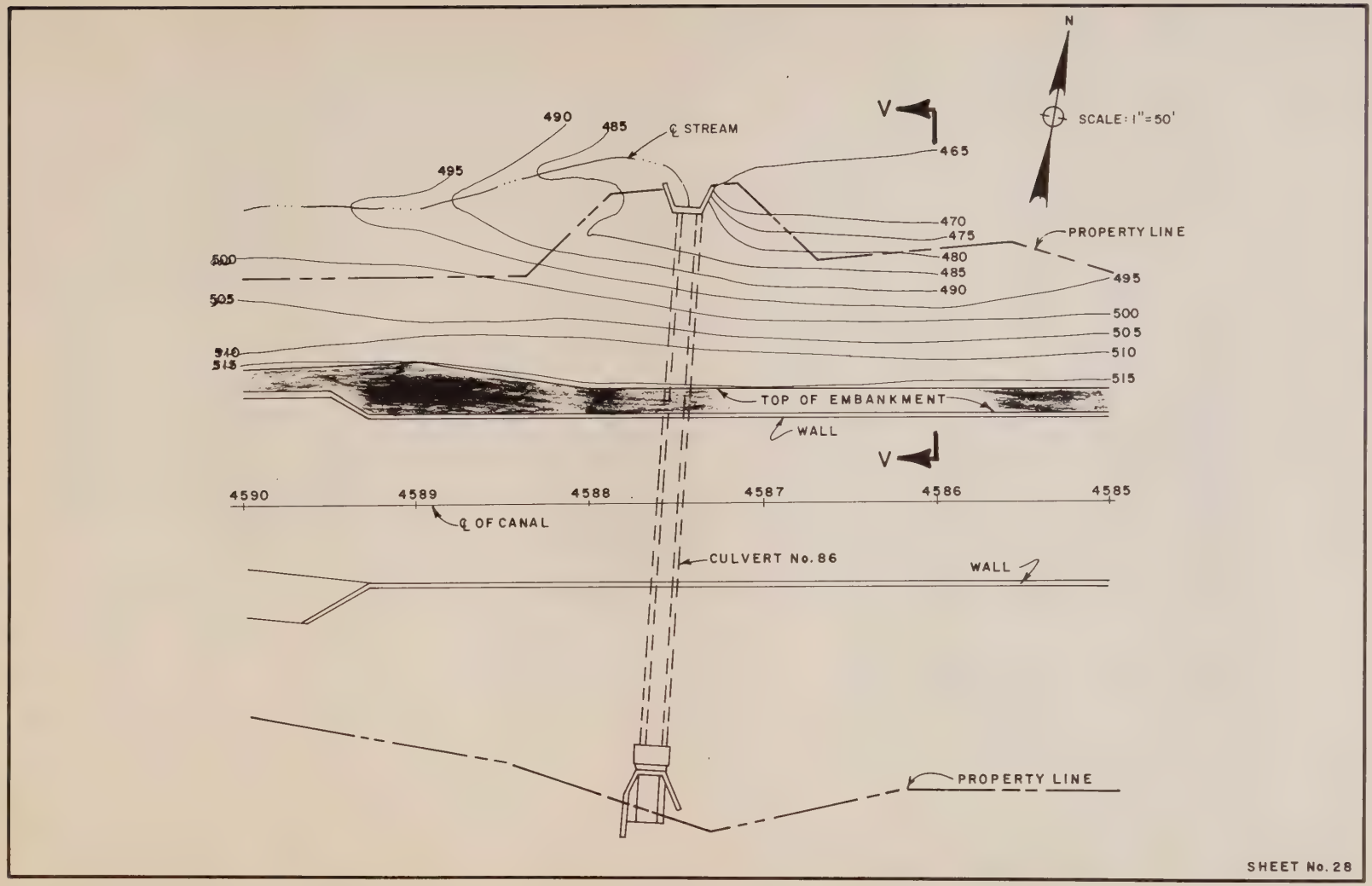
4585+00 - 4590+00

Condition Classification

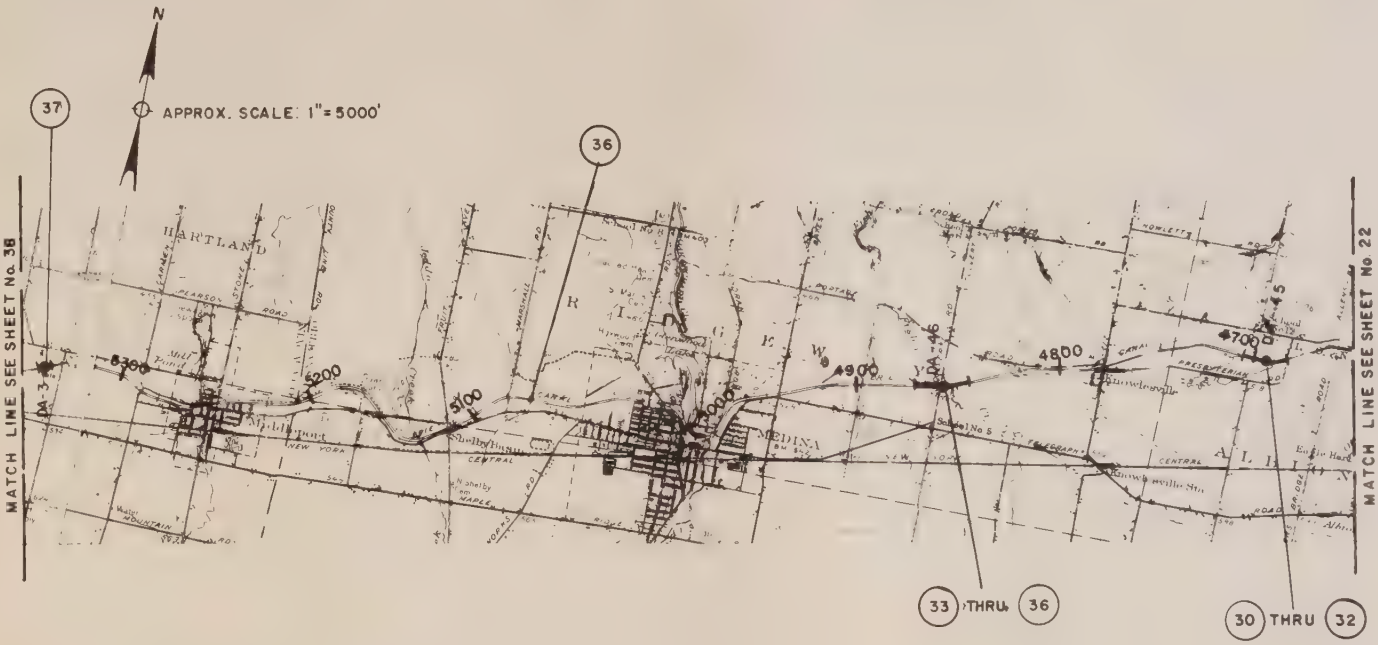
Class 4

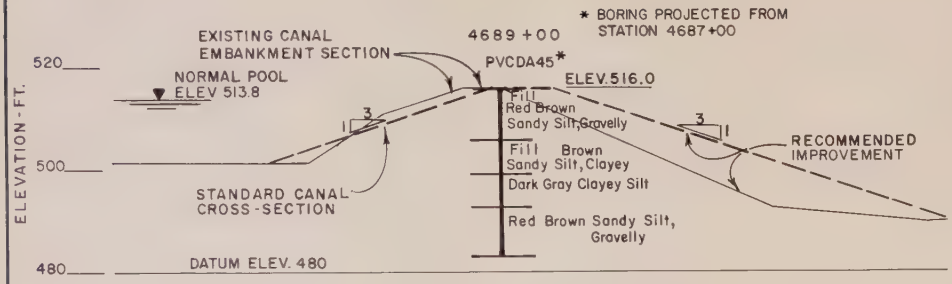
Recommended Foundation Treatment

none


N
SCALE: 1"=50'
V
490
485
℄ STREAM
495
465
470
475
480
485
490
PROPERTY LINE
495
500
505
510
515
500
505
510
515
TOP OF EMBANKMENT
WALL
V
4590
4589
4588
4587
4586
4585
℄ OF CANAL
CULVERT No. 86
WALL
PROPERTY LINE

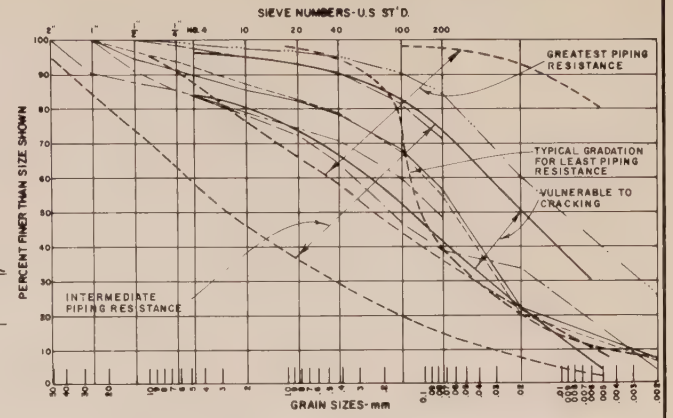
SHEET No. 28


N
APPROX. SCALE: 1"=5000'
37
36
MATCH LINE SEE SHEET No. 38
MATCH LINE SEE SHEET No 22
HARTLAND
MILLPORT
MEDINA
CENTRAL
NEW YORK
PRESBYTERIAN
CANAL
ROAD
5300
5200
5100
5000
4900
4800
4700
33 THRU 36
30 THRU 32
-SHEET NUMBER OF 1"=50' SCALE PLAN



SECTION W-W

SCALE: 1"= 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-45

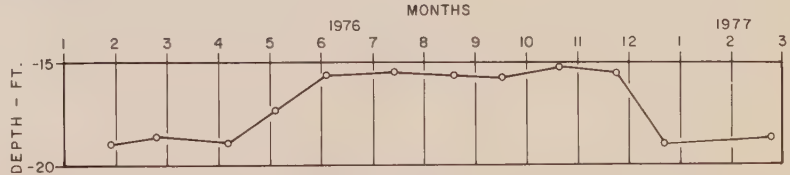
Canal C/L Station

4683+25 - 4702+00

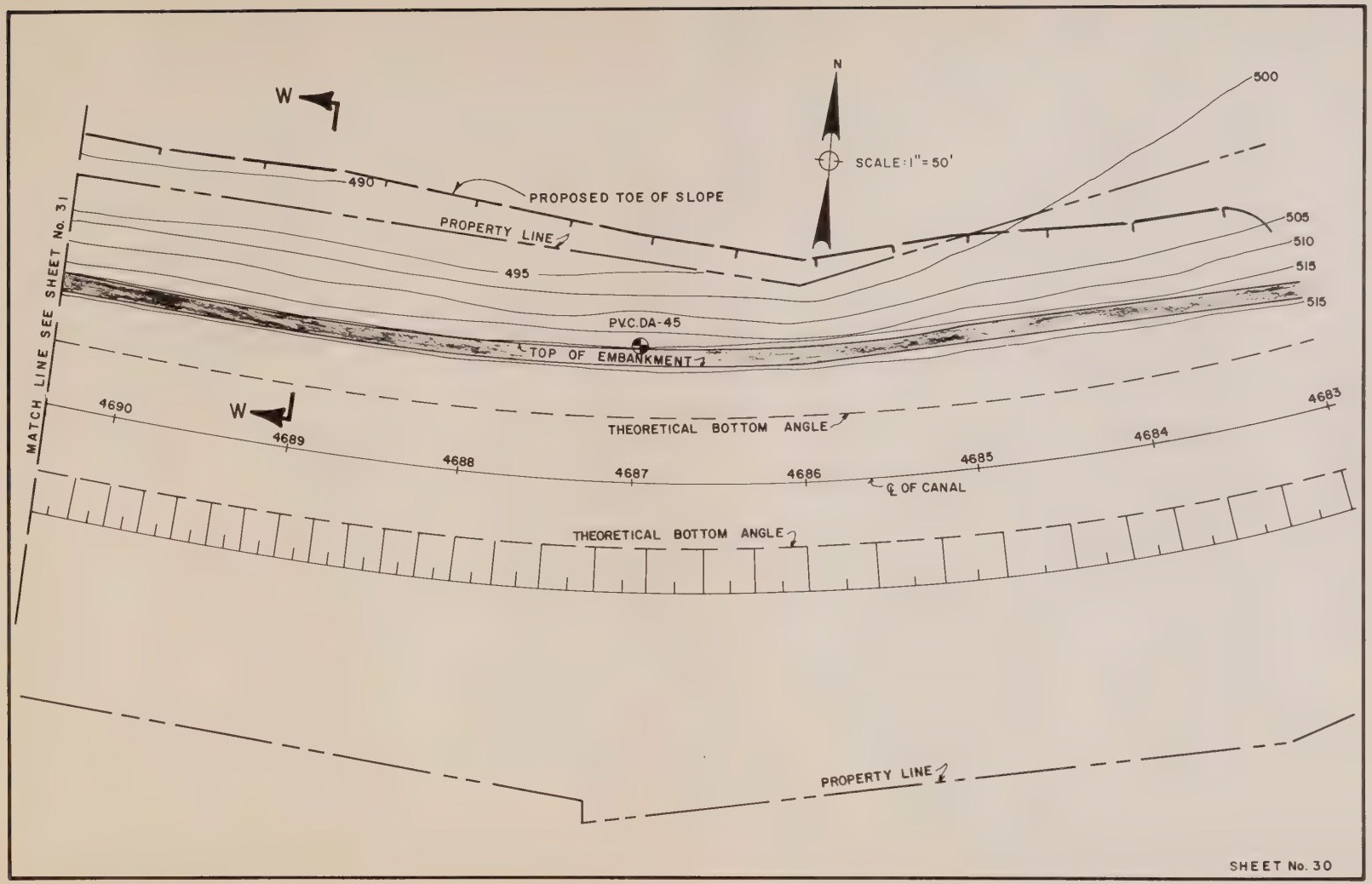
Condition Classification
Class 2

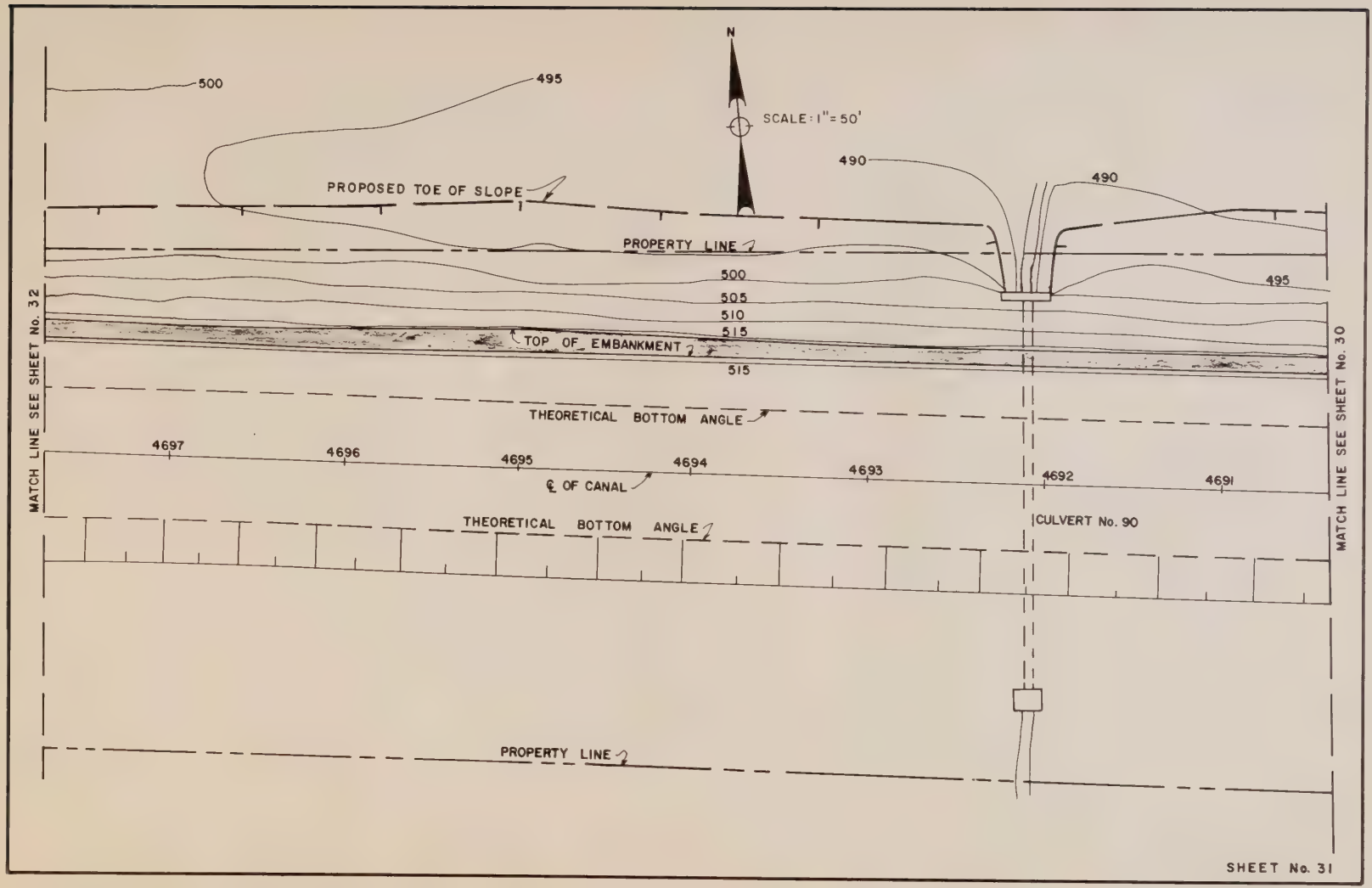
Recommended Foundation Treatment

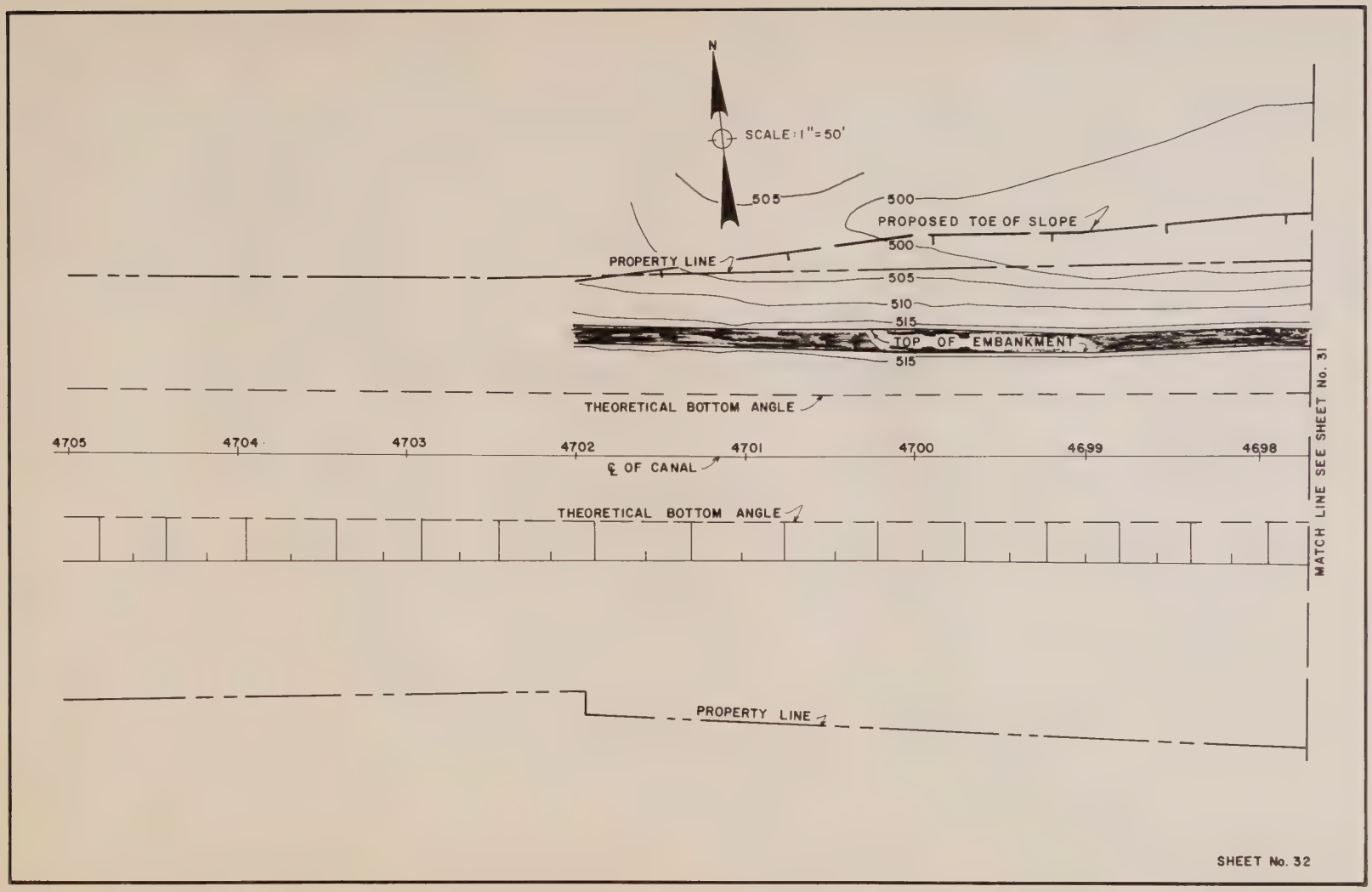
Widen embankment to criteria shown on section W-W and end slope limits on sheets 30-32.
Extend culvert 90 to embankment end limit.

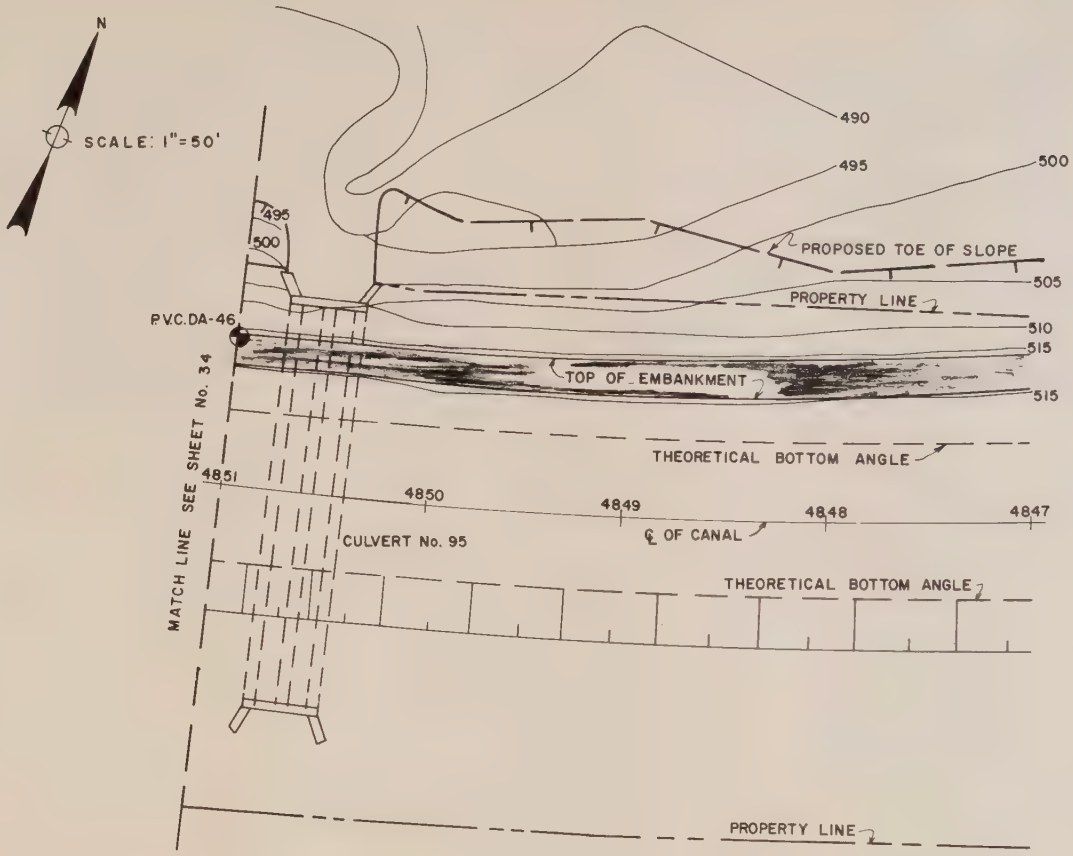


SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-45

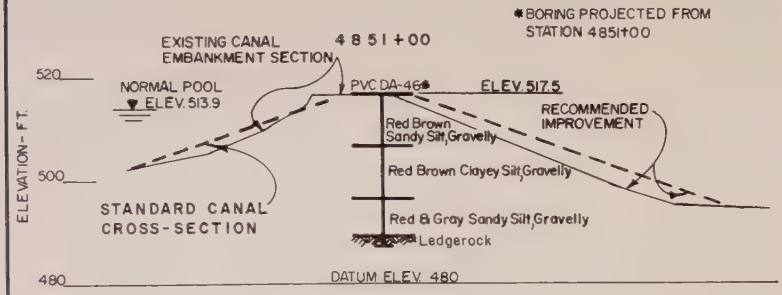

N
W
SCALE: 1"=50'
500
490
PROPOSED TOE OF SLOPE
PROPERTY LINE
505
495
510
515
P.V.C. DA-45
515
TOP OF EMBANKMENT
MATCH LINE SEE SHEET No. 31
4690
W
4689
THEORETICAL BOTTOM ANGLE
4683
4688
4684
4687
4685
4686
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 30


N
SCALE: 1" = 50'
500
495
490
490
PROPOSED TOE OF SLOPE
PROPERTY LINE
500
505
510
515
TOP OF EMBANKMENT
515
495
THEORETICAL BOTTOM ANGLE
4697
4696
4695
4694
4693
4692
4691
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
CULVERT No. 90
PROPERTY LINE
MATCH LINE SEE SHEET No. 32
MATCH LINE SEE SHEET No. 30
SHEET No. 31

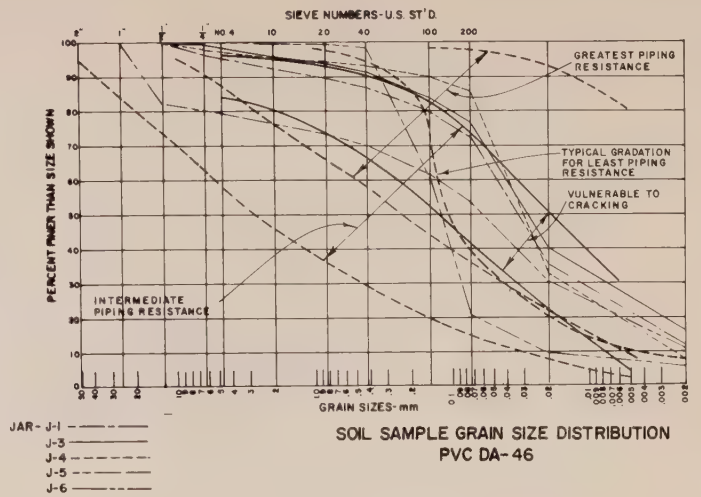

N
SCALE: 1"=50'
505
500
PROPOSED TOE OF SLOPE
500
PROPERTY LINE
505
510
515
TOP OF EMBANKMENT
515
THEORETICAL BOTTOM ANGLE
4705
4704
4703
4702
4701
4700
4699
4698
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 31
PROPERTY LINE
SHEET No. 32


N
SCALE: 1"=50'
490
495
500
495
500
PROPOSED TOE OF SLOPE
505
PROPERTY LINE
P.V.C. DA-46
510
515
TOP OF EMBANKMENT
515
THEORETICAL BOTTOM ANGLE
4851
4850
4849
4848
4847
℄ OF CANAL
CULVERT No. 95
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 34
PROPERTY LINE

SHEET No. 33



SECTION X-X
SCALE 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
PVC DA-46

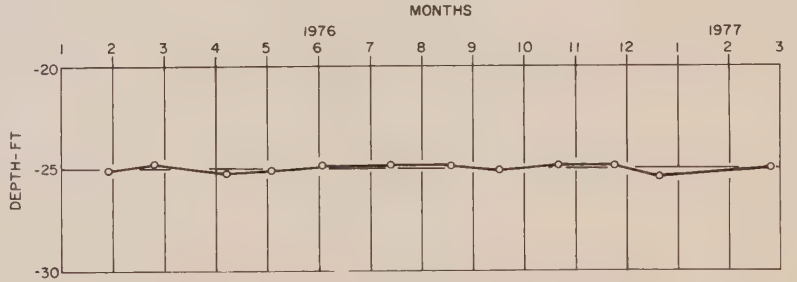
Canal C/L Station

4847+00 - 4855+50

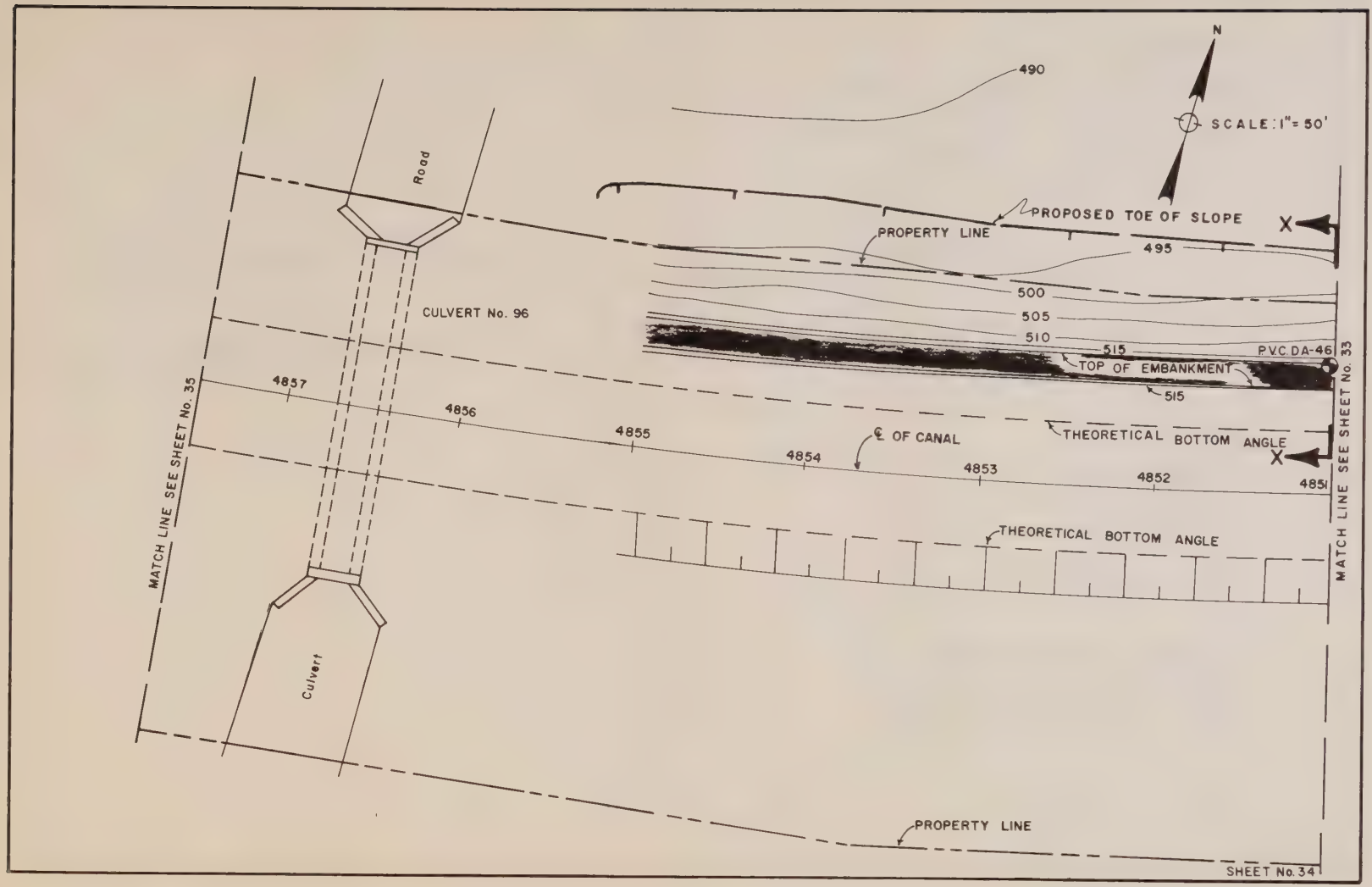
Condition Classification
Class 2

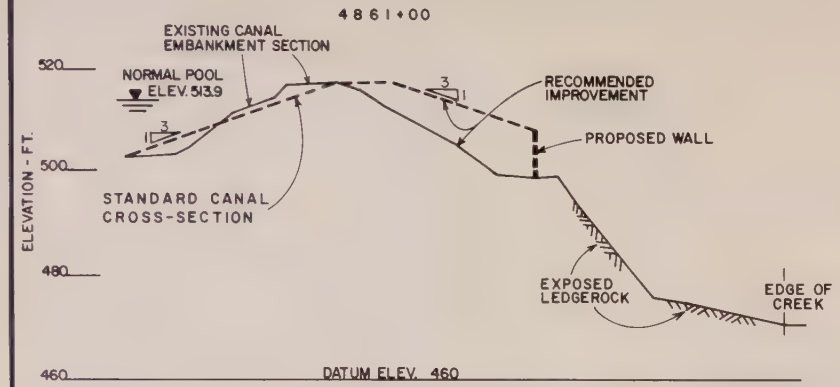
Recommended Foundation Treatment

Widen embankment to criteria shown on section X-X and end slope limits on sheet 33-34. End embankment widening at 4855+50. Extend culvert 95 to end limit of embankment.



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-46


N
SCALE: 1" = 50'
490
Road
PROPOSED TOE OF SLOPE
PROPERTY LINE
495
500
505
510
515
PVC DA-46
TOP OF EMBANKMENT
515
CULVERT No. 96
4857
4856
4855
4854
4853
4852
4851
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 35
MATCH LINE SEE SHEET No. 33
Culvert
PROPERTY LINE
SHEET No. 34



SECTION Y-Y

SCALE 1"=20'

Canal C/L Station

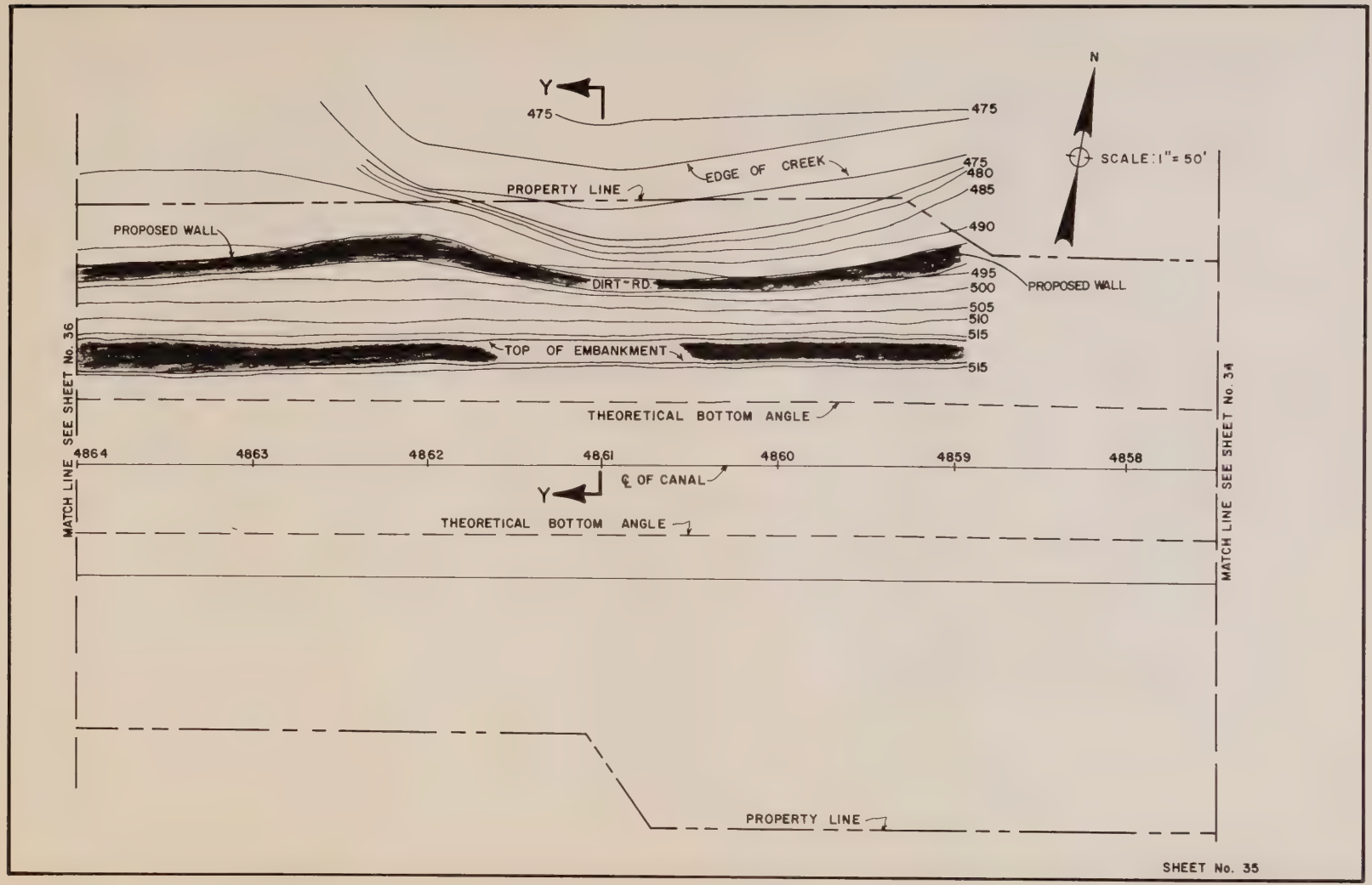
4857+50 - 4869+00

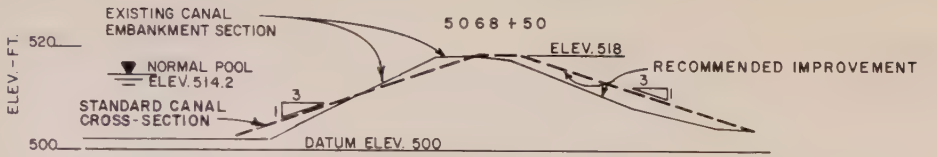
Condition Classification

Class 2

Recommended Foundation Treatment

Construct embankment and precast concrete wall as shown on section Y-Y. Approximate wall location shown on sheets 35 and 36.


N
SCALE: 1" = 50'
Y
475
475
EDGE OF CREEK
475
480
PROPERTY LINE
485
PROPOSED WALL
490
PROPOSED WALL
DIRT-RD.
495
500
505
510
515
TOP OF EMBANKMENT
515
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 36
MATCH LINE SEE SHEET No. 34
4864
4863
4862
4861
4860
4859
4858
℄ OF CANAL
Y
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 35



SECTION Z-Z

SCALE: 1" = 20'

Canal C/L Station

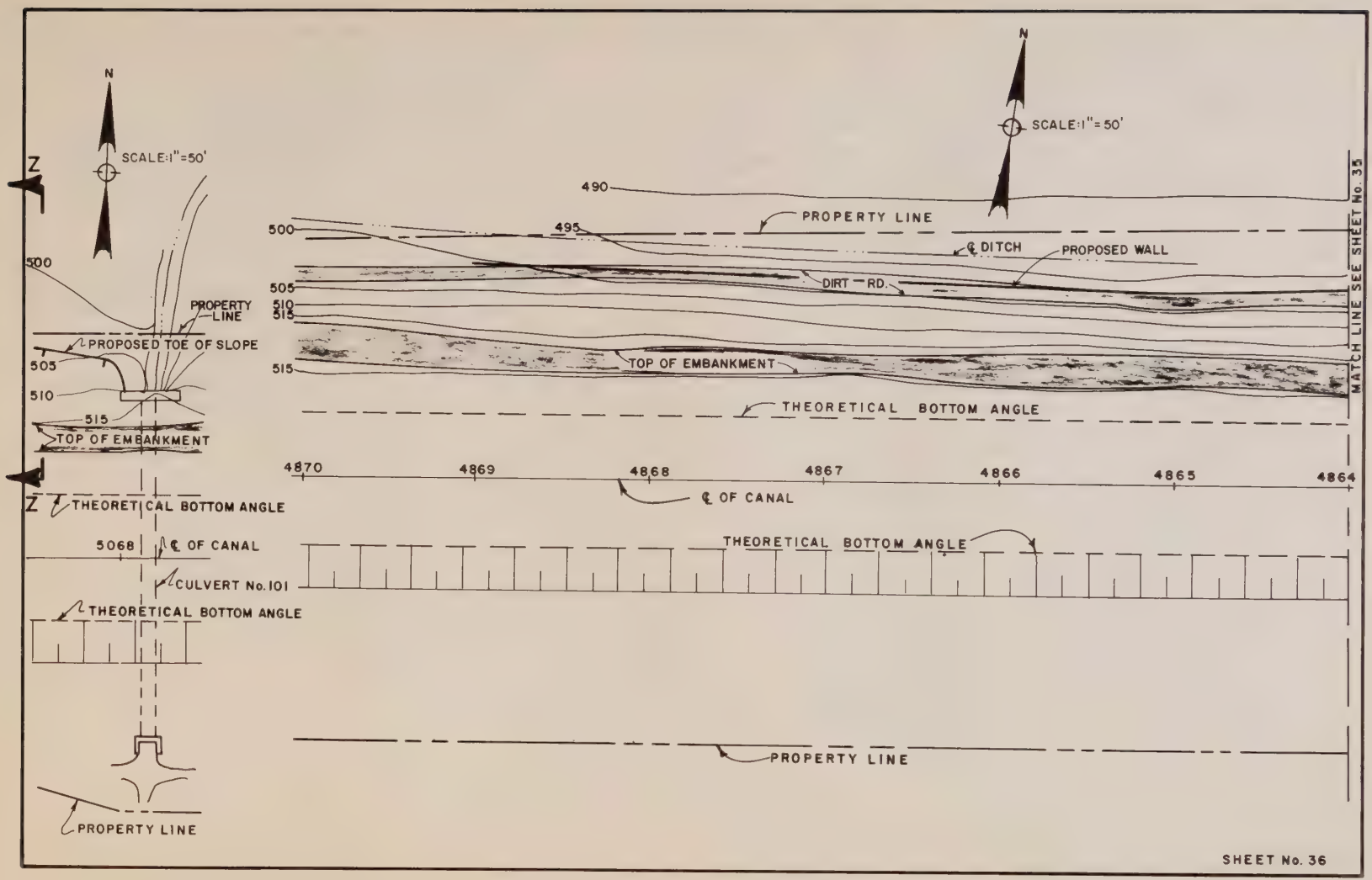
5067+50 - 5068+50

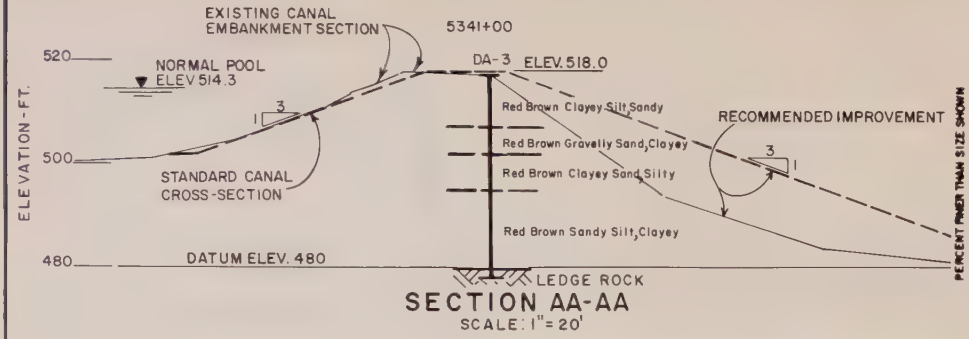
Condition Classification

Class 3

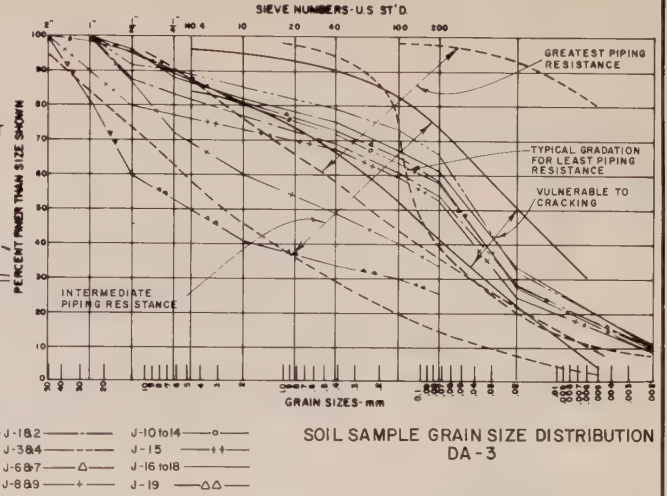
Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section Z-Z and end slope limit on sheet 36. Extend culvert 101 to end limit of embankment.


N
SCALE:1"=50'
Z
500
PROPERTY LINE
PROPOSED TOE OF SLOPE
505
510
515
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
5068
℄ OF CANAL
CULVERT No.101
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
N
SCALE:1"=50'
490
PROPERTY LINE
500
495
℄ DITCH
PROPOSED WALL
DIRT RD.
505
510
515
TOP OF EMBANKMENT
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 35
4870
4869
4868
4867
4866
4865
4864
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 36



SECTION AA-AA
SCALE: 1" = 20'



SOIL SAMPLE GRAIN SIZE DISTRIBUTION
DA-3

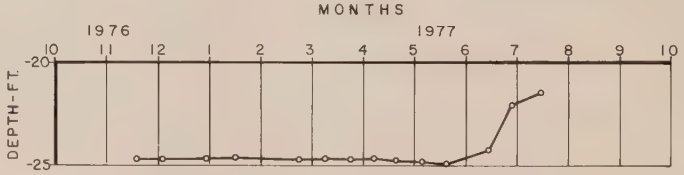
Canal C/L Station

5339+00 - 5342+00

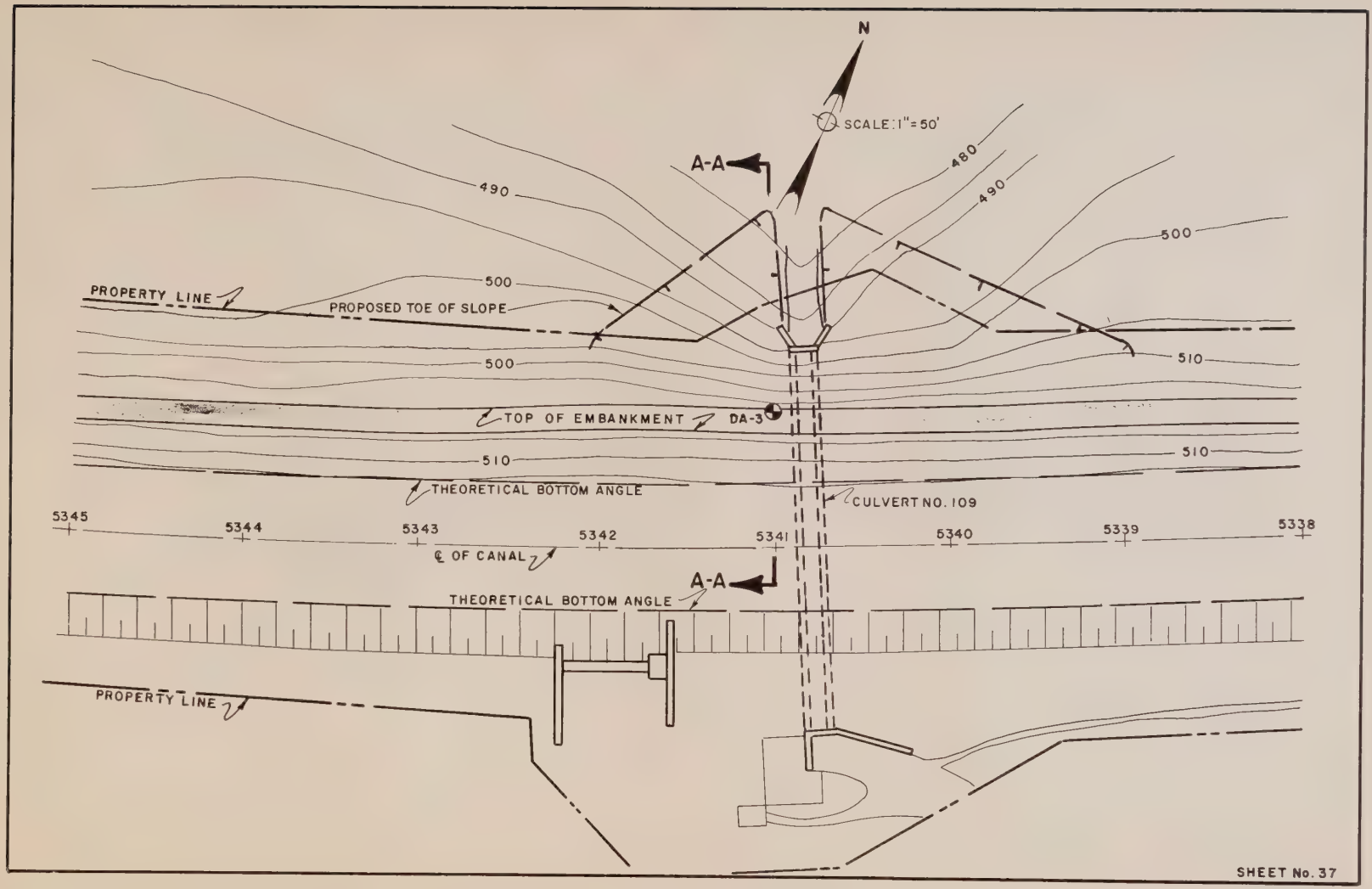
Condition Classification
Class 2

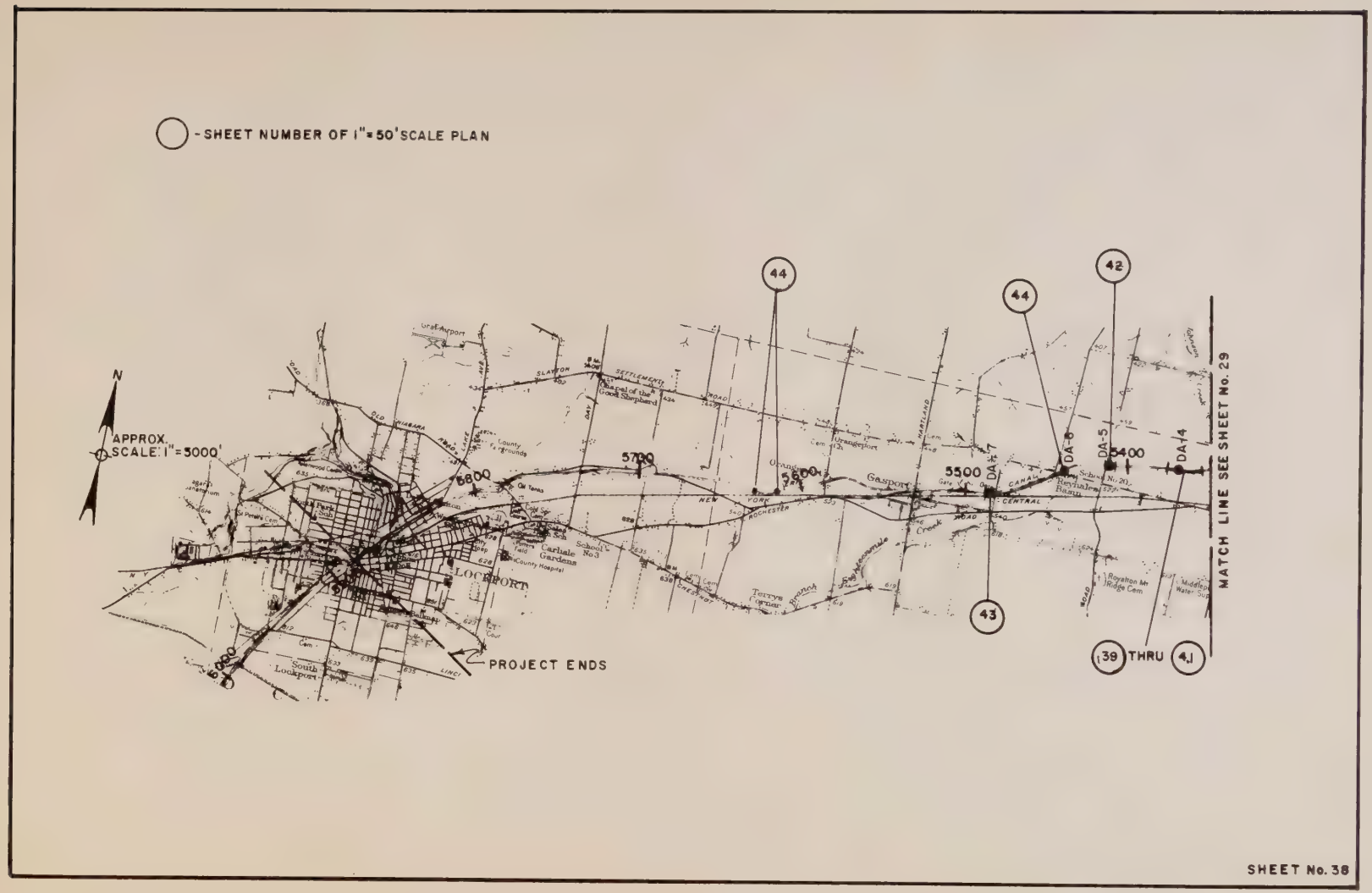
Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section AA-AA and end slope limit shown on sheet 37. Extend culvert 109 to end limit of embankment.



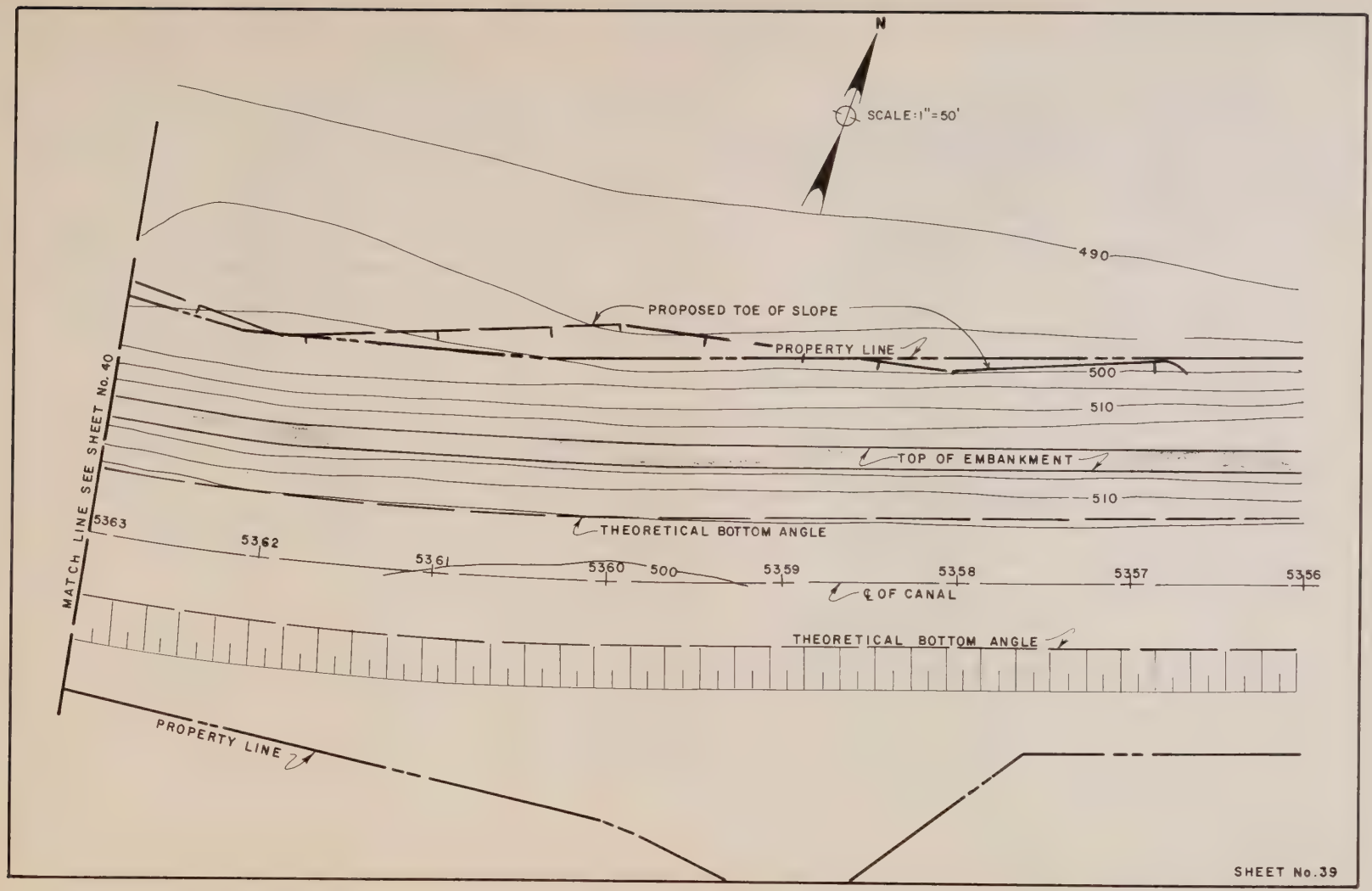
SEASONAL VARIATION IN OBSERVED WATER LEVELS
DA-3

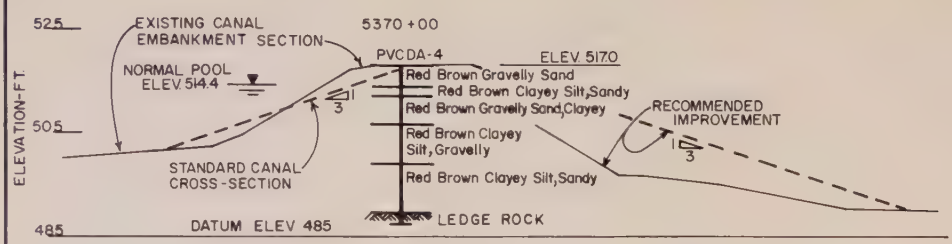

N
SCALE: 1"=50'
A-A
490
480
490
500
PROPERTY LINE
PROPOSED TOE OF SLOPE
500
500
510
TOP OF EMBANKMENT
DA-3
510
510
THEORETICAL BOTTOM ANGLE
CULVERT NO. 109
5345
5344
5343
5342
5341
5340
5339
5338
℄ OF CANAL
A-A
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 37



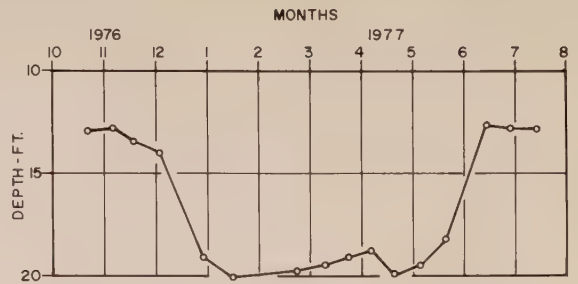
- SHEET NUMBER OF 1"=50' SCALE PLAN
N
APPROX. SCALE: 1"=5000'
PROJECT ENDS
MATCH LINE SEE SHEET No. 29
44
44
42
43
39 THRU 41
5800
5700
5600
5500
5400
DA-7
DA-6
DA-5
DA-4
LOCKPORT
Gasport
Carlisle Gardens
Terrys Corner
Royalton Mt Ridge Cem
South Lockport
Oil Tanks
County Fairgrounds
Chapel of the Good Shepherd
Orangeport
Reynales Basin
Middleport Water Sup

SHEET No. 38


N
SCALE: 1"=50'
490
PROPOSED TOE OF SLOPE
PROPERTY LINE
500
510
TOP OF EMBANKMENT
510
THEORETICAL BOTTOM ANGLE
MATCH LINE SEE SHEET No. 40
5363
5362
5361
5360
500
5359
5358
5357
5356
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
SHEET No. 39



SECTION BB-BB
SCALE 1" = 20'



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-4

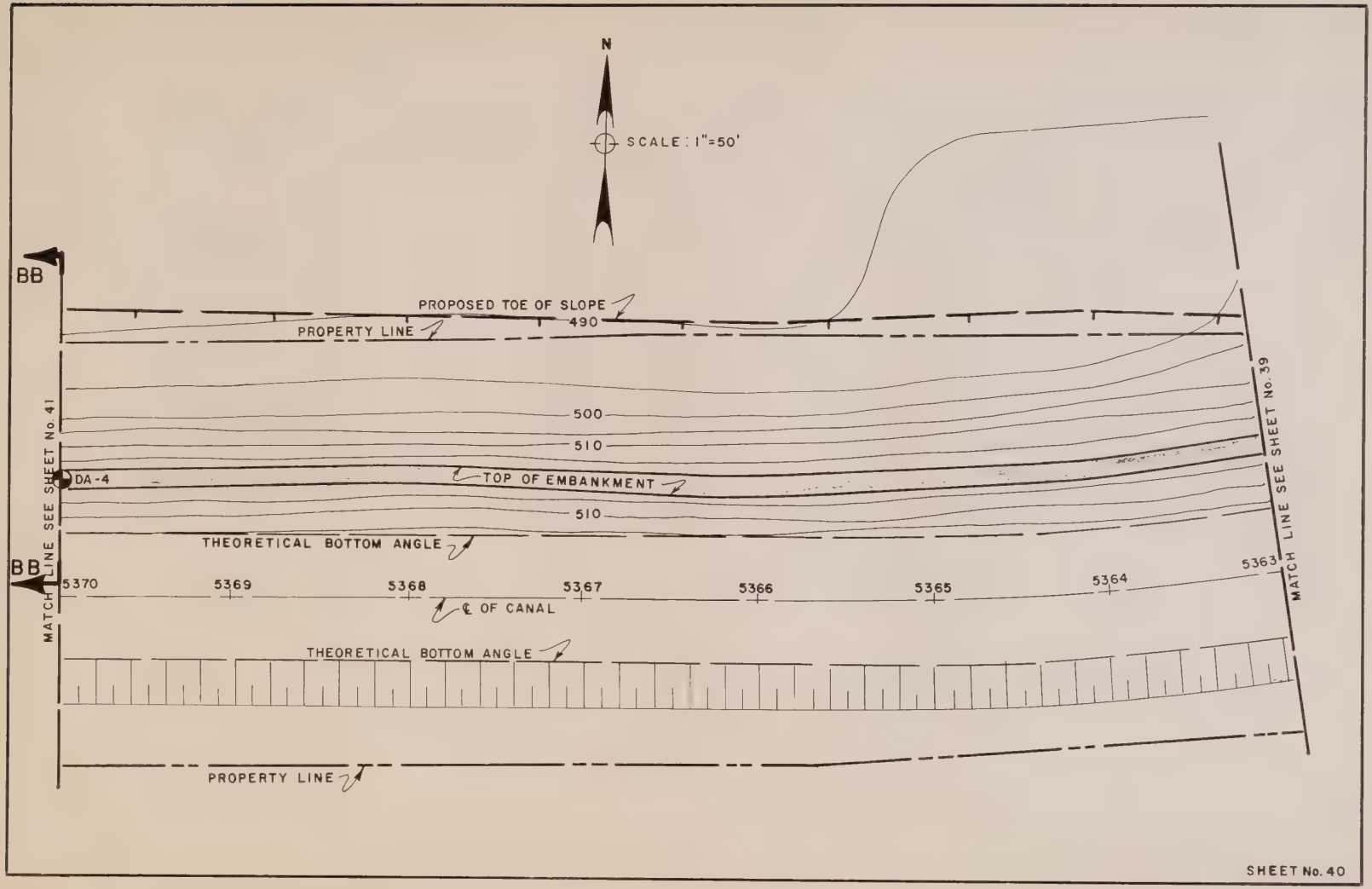
Canal C/L Station

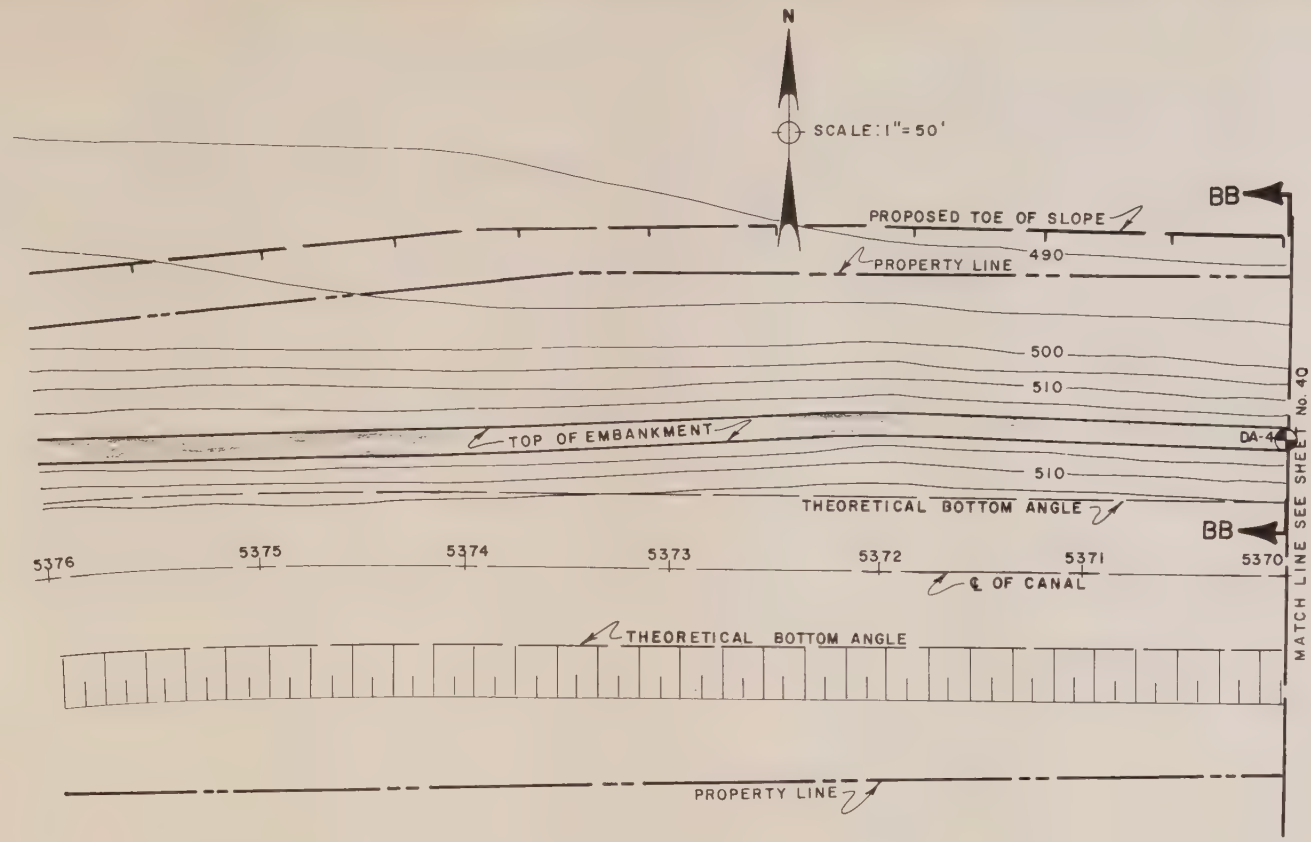
5356+50 - 5376+00

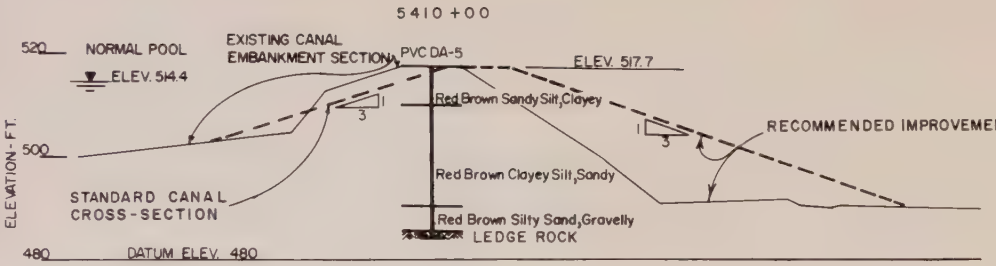
Condition Classification
Class 2

Recommended Foundation Treatment

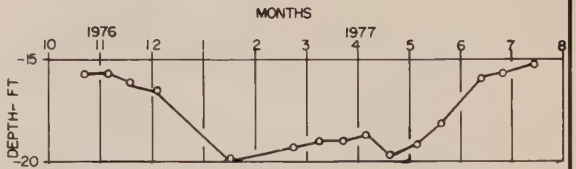
Widen embankment outboard to criteria shown on section BB-BB and end slope limit shown on sheets 39-41.


N
SCALE : 1"=50'
BB
PROPOSED TOE OF SLOPE
490
PROPERTY LINE
500
510
DA-4
TOP OF EMBANKMENT
510
THEORETICAL BOTTOM ANGLE
BB
5370
5369
5368
5367
5366
5365
5364
5363
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 41
MATCH LINE SEE SHEET No. 39
SHEET No. 40


N
SCALE: 1"=50'
BB
PROPOSED TOE OF SLOPE
490
PROPERTY LINE
500
510
TOP OF EMBANKMENT
DA-4
510
THEORETICAL BOTTOM ANGLE
BB
5376
5375
5374
5373
5372
5371
5370
℄ OF CANAL
THEORETICAL BOTTOM ANGLE
PROPERTY LINE
MATCH LINE SEE SHEET No. 40



SECTION CC-CC
SCALE 1" = 20'



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-5

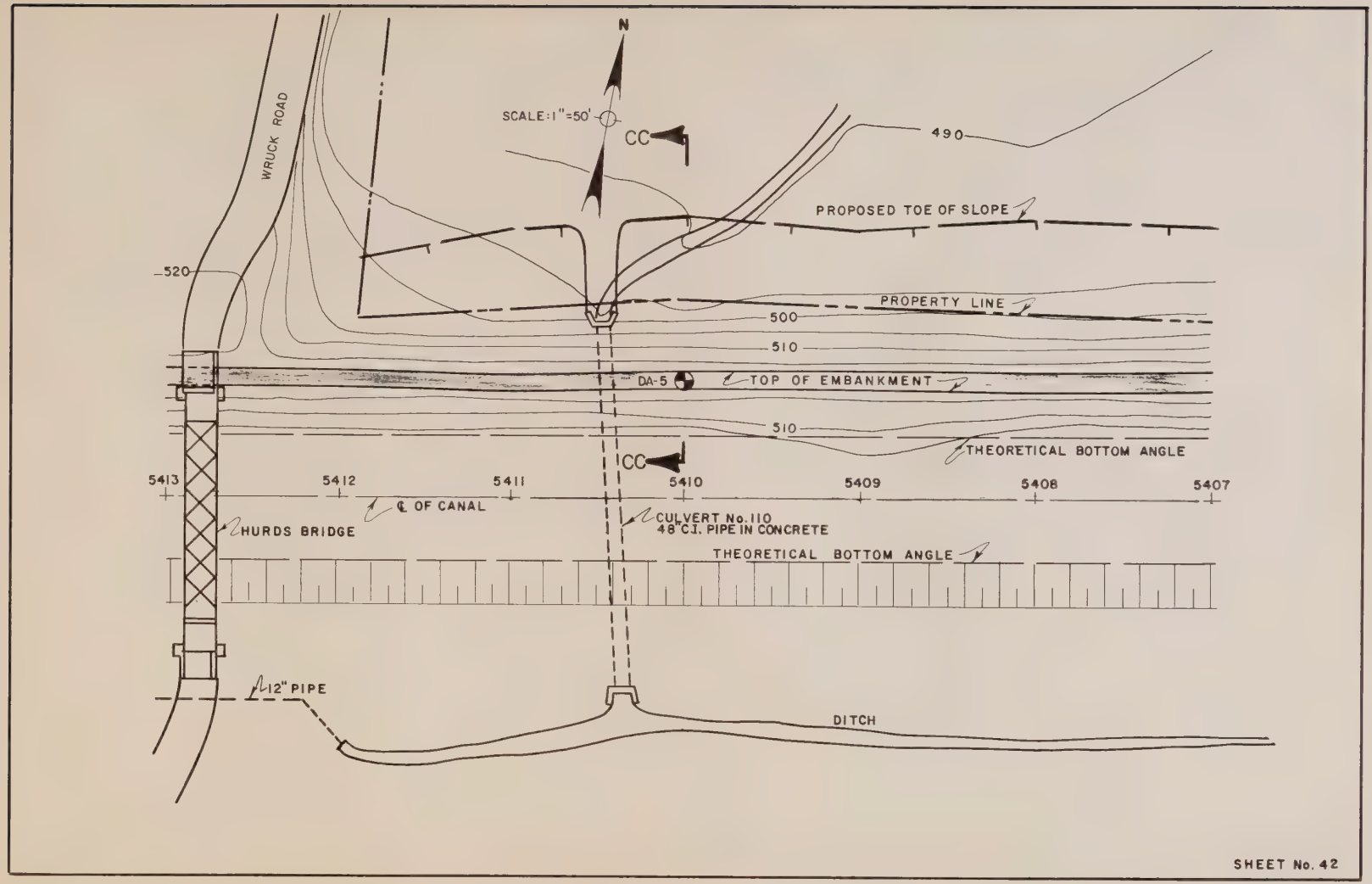
Canal C/L Station

5407+00 - 5412+00

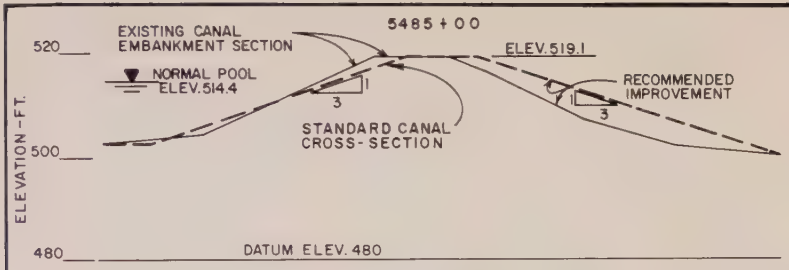
Condition Classification
Class 2

Recommended Foundation Treatment

Widen embankment outboard to criteria shown on section CC-CC and end slope limit shown on sheet 42. Extend culvert 110 to end limit of embankment.


N
SCALE: 1"=50'
CC
WRUCK ROAD
490
PROPOSED TOE OF SLOPE
520
PROPERTY LINE
500
510
DA-5
TOP OF EMBANKMENT
510
CC
THEORETICAL BOTTOM ANGLE
5413
5412
5411
5410
5409
5408
5407
℄ OF CANAL
HURDS BRIDGE
CULVERT No. 110
48" C.I. PIPE IN CONCRETE
THEORETICAL BOTTOM ANGLE
12" PIPE
DITCH

SHEET No. 42



SECTION DD-DD

SCALE : 1" = 20'

Canal C/L Station

5474+50 - 5487+00

Condition Classification

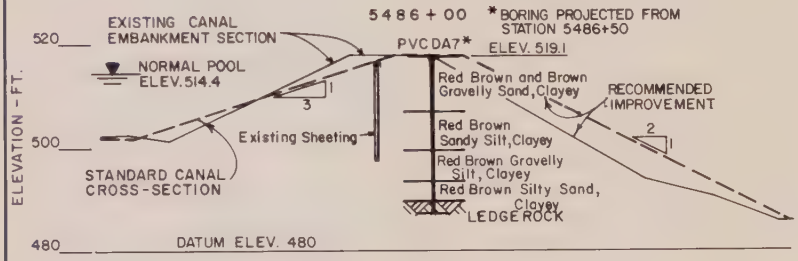
Class 2

Recommended Foundation Treatment

5484+50 - 5485+25 - Widen embankment outboard according to section DD-DD and end slope limit on sheet 43

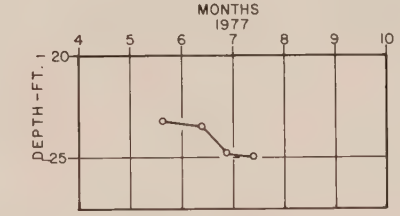
5485+50 - 5487+15 - Widen embankment outboard to criteria shown on section EE-EE and end slope limit on sheet 43

Extend culvert 113 to end limit of embankment.

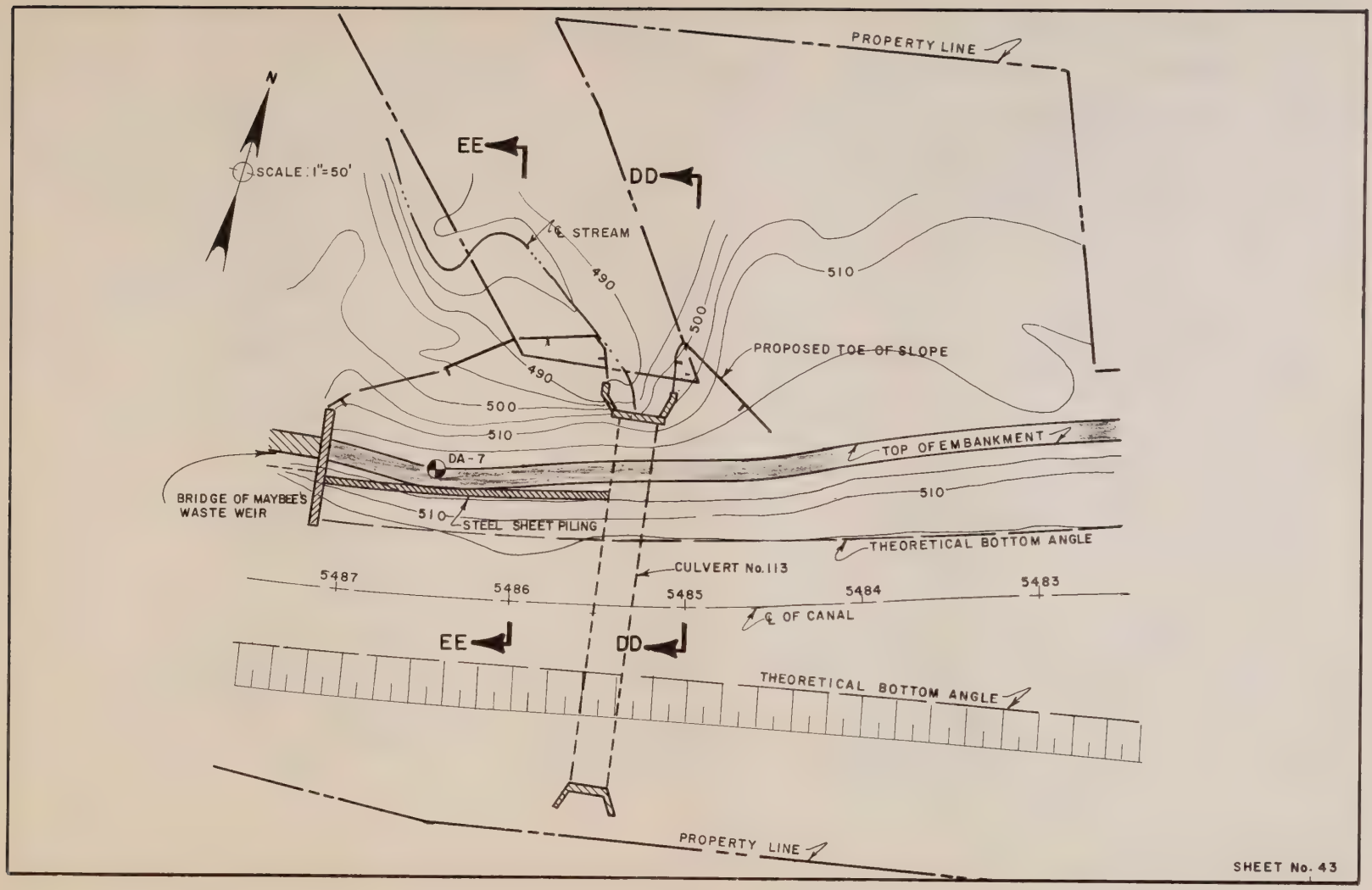


SECTION EE-EE

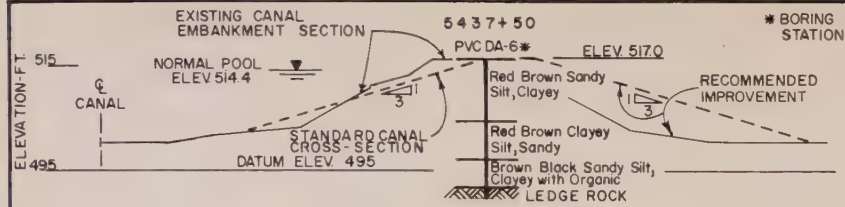
SCALE : 1" = 20'



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-7

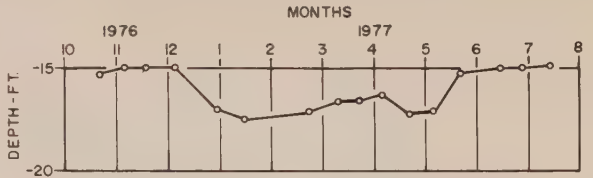

N
SCALE: 1"=50'
EE
DD
PROPERTY LINE
℄ STREAM
490
500
510
PROPOSED TOE OF SLOPE
TOP OF EMBANKMENT
DA-7
BRIDGE OF MAYBEE'S WASTE WEIR
STEEL SHEET PILING
THEORETICAL BOTTOM ANGLE
CULVERT No.113
5487
5486
5485
5484
5483
℄ OF CANAL
PROPERTY LINE

SHEET No. 43

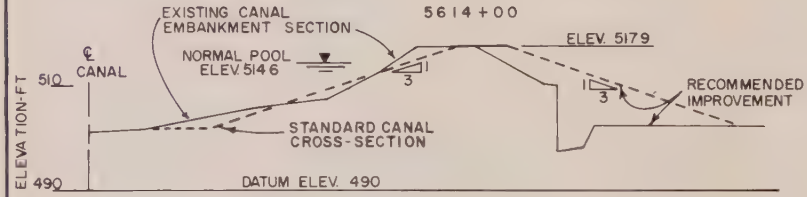


SECTION FF-FF
SCALE 1" = 20'

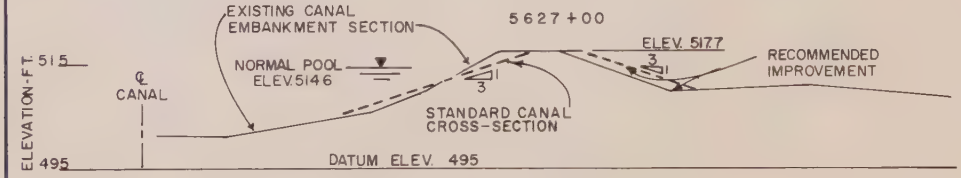
* BORING PROJECTED FROM STATION 5436+50



SEASONAL VARIATION IN OBSERVED WATER LEVELS
PVC DA-6



SECTION GG-GG
SCALE 1" = 20'



SECTION HH-HH
SCALE 1" = 20'

Canal C/L Station

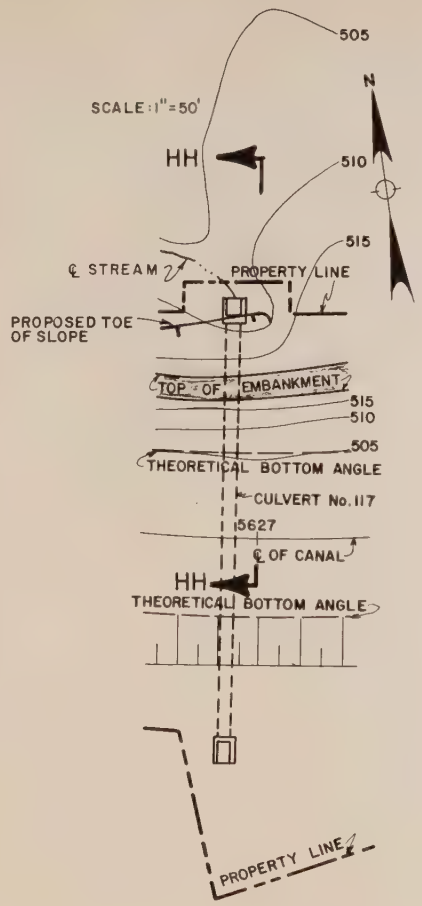
1. 5436+50 - 5437+50
2. 5613+75 - 5614+25
3. 5627+00 - 5627+50

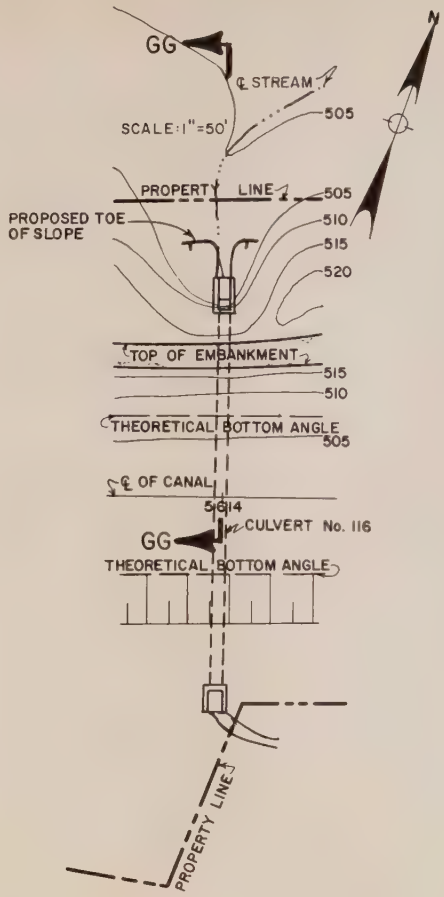
Condition Classification

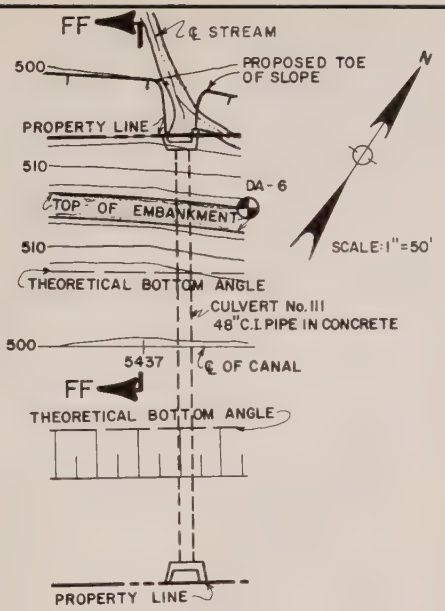
1. Class 2
2. Class 3
3. Class 3

Recommended Foundation Treatment

Widen embankments outboard according to criteria on respective section and end slope limit on sheet 44.
Extend culverts 111 and 116 to end limit of embankment.


505
SCALE: 1"=50'
N
HH
510
515
℄ STREAM
PROPERTY LINE
PROPOSED TOE OF SLOPE
TOP OF EMBANKMENT
515
510
505
THEORETICAL BOTTOM ANGLE
CULVERT No. 117
5627
℄ OF CANAL
HH
THEORETICAL BOTTOM ANGLE
PROPERTY LINE


GG
℄ STREAM
505
SCALE: 1"=50'
N
PROPERTY LINE
505
PROPOSED TOE OF SLOPE
510
515
520
TOP OF EMBANKMENT
515
510
THEORETICAL BOTTOM ANGLE
505
℄ OF CANAL
5614
CULVERT No. 116
GG
THEORETICAL BOTTOM ANGLE
PROPERTY LINE


FF
℄ STREAM
500
PROPOSED TOE OF SLOPE
N
PROPERTY LINE
510
DA-6
TOP OF EMBANKMENT
SCALE: 1"=50'
510
THEORETICAL BOTTOM ANGLE
CULVERT No. 111
48" C.I. PIPE IN CONCRETE
500
5437
℄ OF CANAL
FF
THEORETICAL BOTTOM ANGLE
PROPERTY LINE

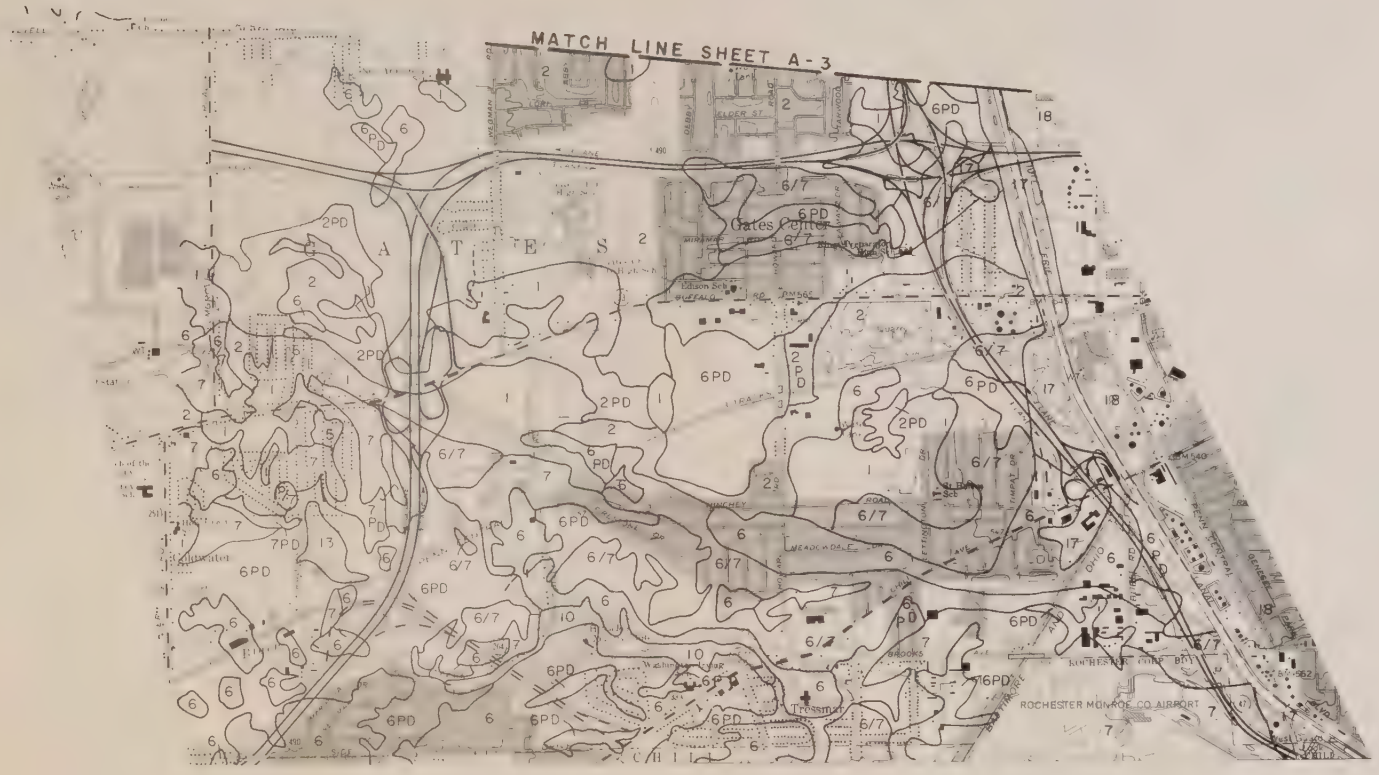
APPENDIX

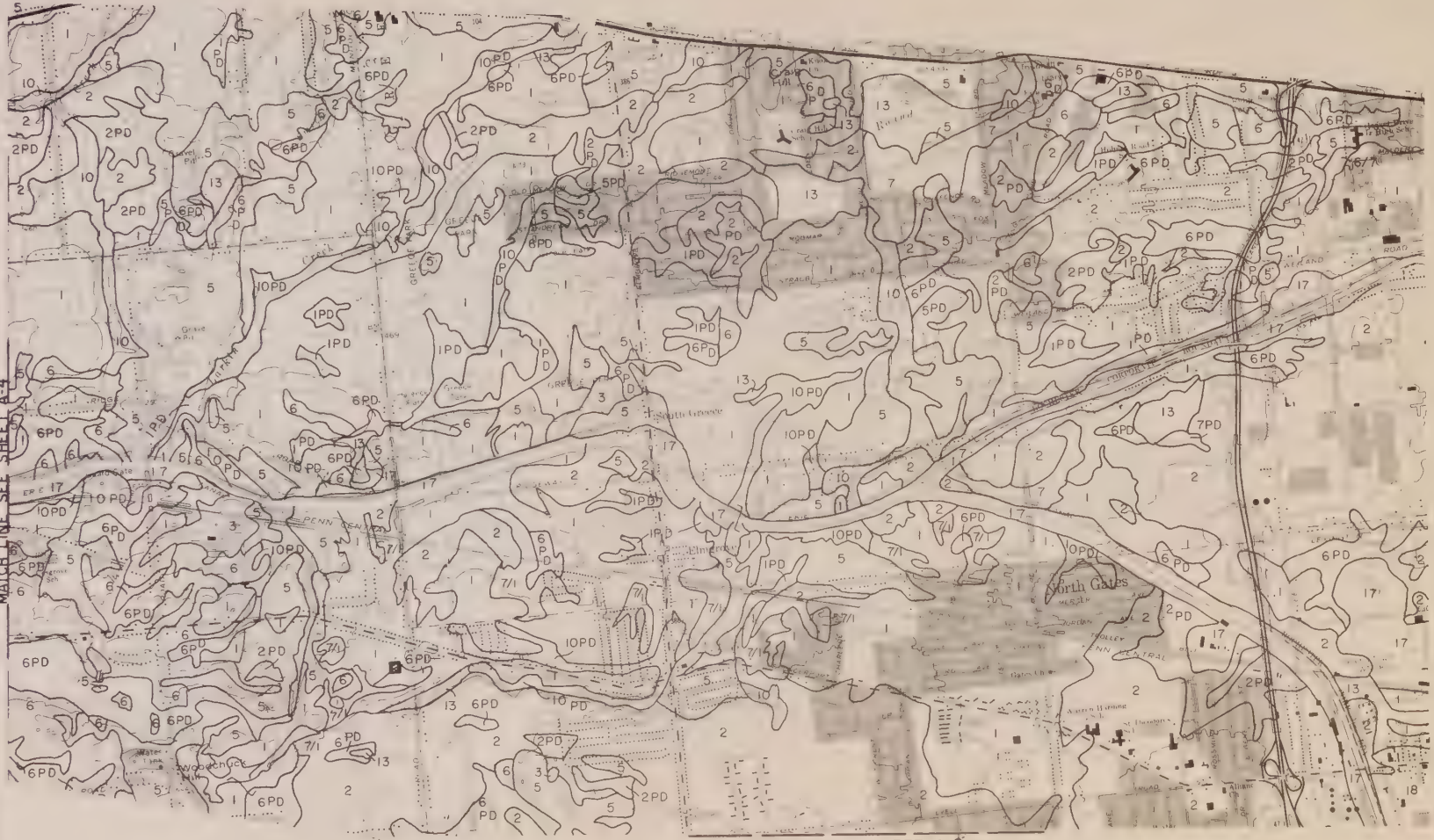
1	THICK TILL
2	THIN TILL
2&15	THIN TILL AND BEDROCK
3	MORANIC TILL
5	OUTWASH DEPOSITS
6	LACUSTRINE SHORE DEPOSITS
6/7	LACUSTRINE SHORE DEPOSITS OVER LACUSTRINE BOTTOM SEDIMENTS
7	LACUSTRINE BOTTOM SEDIMENTS
7/6	LACUSTRINE BOTTOM SEDIMENTS OVER LACUSTRINE SHORE DEPOSITS
7/1	LACUSTRINE BOTTOM SEDIMENTS OVER THICK TILL
10	RECENT ALLUVIAL DEPOSITS
13	ORGANIC DEPOSITS
15	BEDROCK OUTCROP
17	MAN-MADE FEATURES
18	URBAN LAND
⺌	WET SPOT
⺌	MARSH
W	STANDING WATER
PD	POORLY DRAINED VARIANT

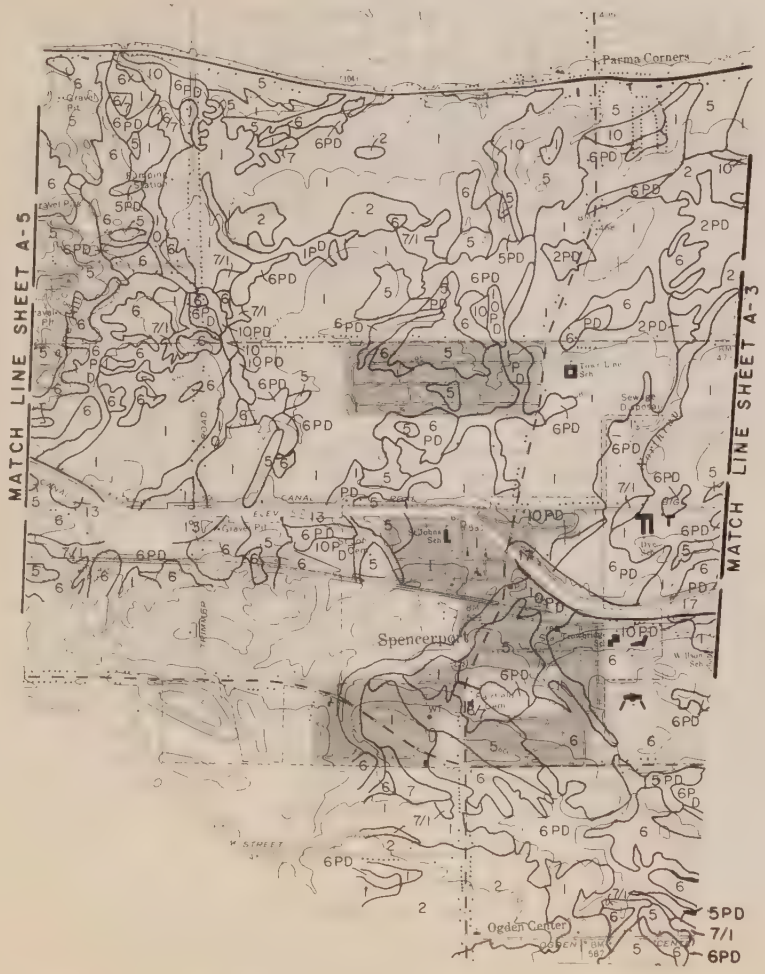
SCALE 1: 24000

1 1/2 0 1 MILE

CONTOUR INTERVAL 10 FT


MATCH LINE SHEET A-3
Gates Center
ROCHESTER MONROE CO AIRPORT

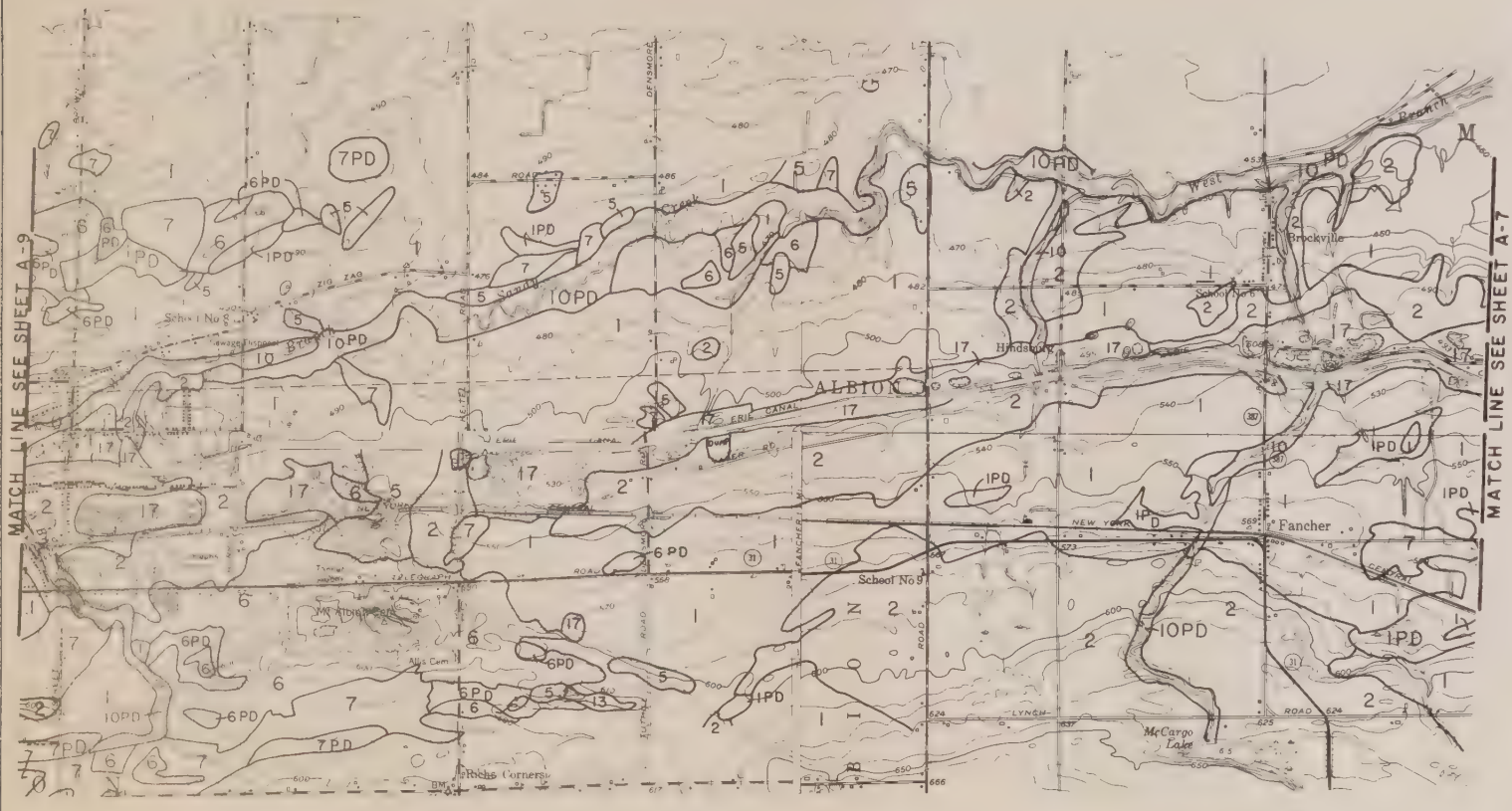

MATCH LINE SEE SHEET A-4
MATCH LINE SEE SHEET A-2
North Gates

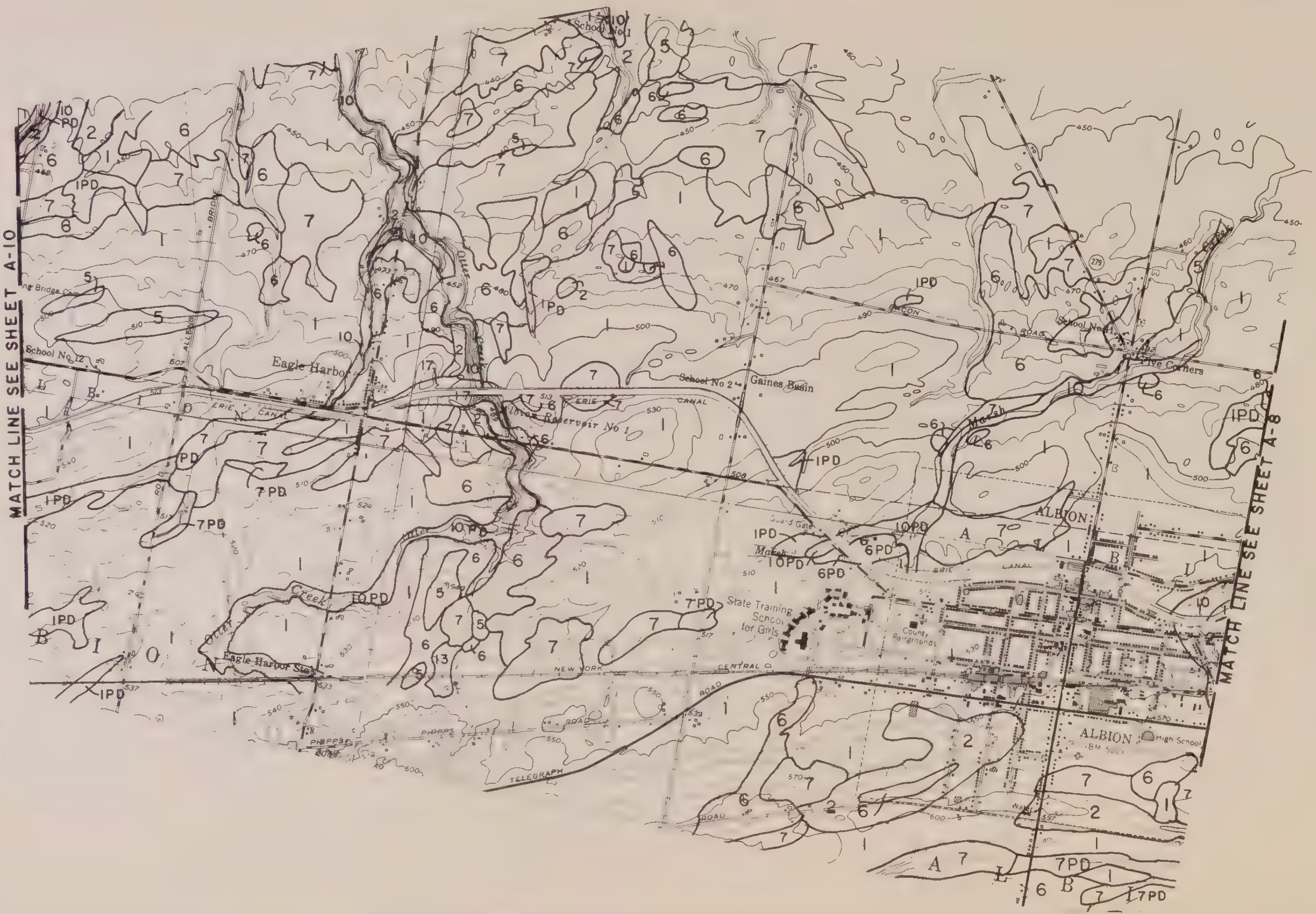

MATCH LINE SHEET A-5
MATCH LINE SHEET A-3
Parma Corners
Spencerport
Ogden Center
5PD
7/1
6PD

MATCH LINE SHEET A-6
MATCH LINE SHEET A-4
BROCKPORT
Garland
Trainer Park
Hinkleyville
Adams Basin
PENN CENTRAL
GORDON ROAD
GARDNER RD
East Sweden

MATCH LINE SEE SHEET A-7
MATCH LINE SEE SHEET A-5
Holley
NEW YORK
CENTRAL
EDMUNDS
ROAD
East Branch
West
Fork
MONROE CO
Lakeside Mem Hospital
Fire Sta
Park
Water Tank
Gravel

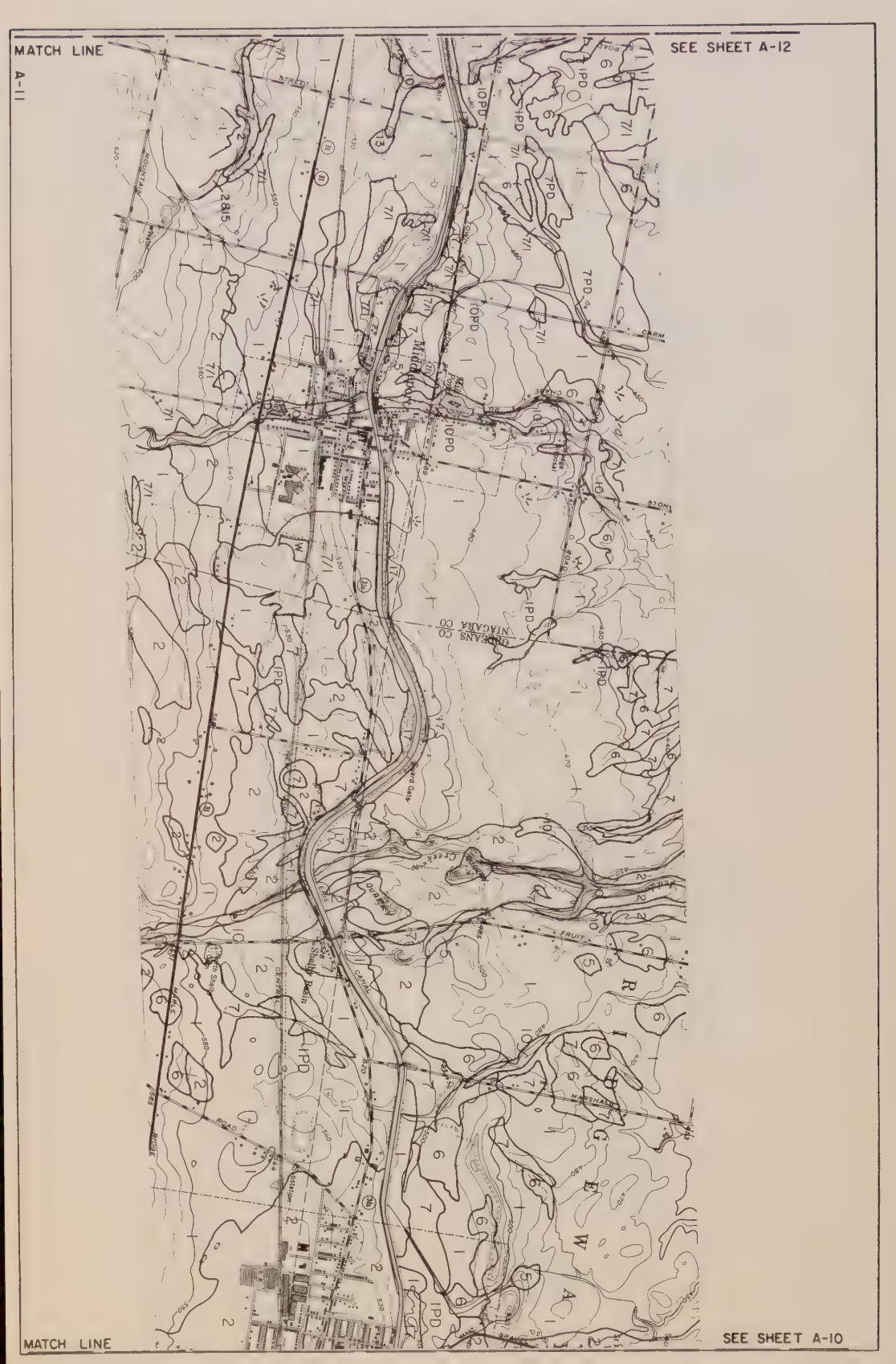
MATCH LINE SEE SHEET A-8
MATCH LINE SEE SHEET A-6
Hulberton
QUARRY
School No. 1
SKILLINGTON ROAD
TELEGRAPH
LYNCH ROAD
Branch
1PD
10PD


MATCH LINE SEE SHEET A-9
MATCH LINE SEE SHEET A-7
ALBION
Hindsburg
Brockville
Fancher
School No 9
Richs Corners
McCargo Lake
Sandy Creek
West Branch
ERIE CANAL
NEW YORK
LYNCH ROAD
DENSMORE
ZIG ZAG
Mt Albion Cem
Allis Cem
7PD
6PD
10PD
1PD
17
2
5
6
7


MATCH LINE SEE SHEET A-10
MATCH LINE SEE SHEET A-8
School No 1
School No 12
Eagle Harbor
School No 2
Gaines Basin
ERIE CANAL
Five Corners
ALBION
State Training School for Girls
County Fairgrounds
Eagle Harbor Sta
NEW YORK CENTRAL
Otter Creek
Marsh
High School
TELEGRAPH
PHIPPS
ROAD

A - 9

SEE SHEET A-11
SHEE A-9
MATCH LINE
MATCH LINE SEE
Glenwood
Lake
Medina
MEDINA
Knowlesville
Knowlesville Sta
School No 5
School No 6
NEW YORK
CENTRAL
PRESBYTERIAN
ROAD
HOWLETT
PORTER
ROAD
CANAL
TELEGRAPH
ROAD
1PD
6PD
7PD
10PD


MATCH LINE
A-11
SEE SHEET A-12
MATCH LINE
SEE SHEET A-10
Middleport
Shelby Basin
IPD
10PD
7PD
7/1
DUNCANS CO
NIAGARA CO
CANAL
ROAD
STREET
FRUIT
CENTRAL
MARSHALL
RIDGE
STONE
CHURCH
CREEK
BRANCH
SCHOOL
2815

SHEET A-13

SHEET A-11

MATCH LINE SEE

MATCH LINE SEE

A-12
MATCH LINE SEE SHEET
A-13
LOCKPORT
Highland Park
Nottingham Estates
ERIE CANAL
NEW YORK CENTRAL
10PD
7PD
6PD
1PD
7/1
2815

GENERAL TERRAIN UNIT CHARACTERISTICS

MAP SYMBOL	TERRAIN UNIT	MODE OF ORIGIN	LANDFORMS	COMMON TOPOGRAPHIC POSITION	PARTICLE SIZE AND DISTRIBUTION	RELATIVE PERMEABILITY	REMARKS
1	THICK TILL	SEDIMENTS PICKED UP, TRANSPORTED, MIXED, AND DEPOSITED BY GLACIAL ICE; MINIMAL WATER TRANSPORT; COMPACTION BY OVERRIDING ICE OR SETTLING DURING DEWATERING.	LONG, SIMPLE SLOPES; STEEP TO LEVEL SURFACES; DRUMLINS.	UPLANDS; FLANKS AND TOPS OF HILLS.	CLAY TO BOULDERS; -3" FRACTION MOSTLY SAND AND SILT. GENERALLY UNSORTED AND UNSTRATIFIED; MINOR WATER-SORTED POCKETS.	SLOW	HARD LAYER NEAR SURFACE MAY PREVENT DOWNWARD MOVEMENT OF WATER.
2	THIN TILL	SEDIMENTS PICKED UP, TRANSPORTED, MIXED, AND DEPOSITED BY GLACIAL ICE; MINIMAL WATER TRANSPORT; COMPACTION BY OVERRIDING ICE OR SETTLING DURING DEWATERING.	MODERATELY STEEP TO STEEP VALLEY SIDES; HILLTOPS	STEEPER UPLAND SLOPES; INCISED DRAINAGEWAYS.	CLAY TO BOULDERS; -3" FRACTION MOSTLY SAND AND SILT. GENERALLY UNSORTED AND UNSTRATIFIED; MINOR WATER-SORTED POCKETS.	SLOW	DEPTH TO BEDROCK LESS THAN FOUR FEET; NUMEROUS ROCK FRAGMENTS NEAR BEDROCK SURFACE.
3	MORAINIC TILL	SEDIMENTS DUMPED FROM MARGIN OF MELTING ICE; PARTIALLY WATER-WORKED	LONG COMPLEX SLOPES; IRREGULAR HILLY SURFACES.	UPLANDS; LOWER VALLEY WALLS.	CLAY TO BOULDERS; -3" FRACTION MOSTLY SAND AND SILT. UNSORTED OR VERY POOR SORTING; LITTLE OR NO STRATIFICATION.	MODERATE TO RAPID	USUALLY OCCURS WITHIN OR CLOSELY ASSOCIATED WITH THICK TILL OR ICE-CONTACT DEPOSITS.
4	ICE-CONTACT DEPOSITS	WATERBORNE SEDIMENTS DEPOSITED AGAINST ONE OR MORE WALLS OF ICE.	KAMES, ESKERS, ETC.; SINUOUS RIDGES OR RANDOM CONICAL HILLS AND DEPRESSIONS OF MODERATE RELIEF.	VALLEY WALLS AND FLOORS SUPERIMPOSED ON LANDSCAPE.	SILT, SAND, GRAVEL; OCCASIONAL COBBLES. WELL-SORTED BEDS. IRREGULAR, FAULTED AND SLUMPED STRATIFICATION.	MODERATE TO RAPID	ASSOCIATED WITH MORAINIC TILL DEPOSITS.
5	OUTWASH DEPOSITS	SEDIMENTS TRANSPORTED BY MELTWATERS AWAY FROM ICE MASS.	FLAT TO GENTLY UNDULATING TERRACES.	LOWER VALLEY WALLS AND FLOORS.	SILT TO COBBLES, MOSTLY SAND AND GRAVEL. WELL-SORTED, MASSIVE, HORIZONTAL STRATIFICATION WITH SOME BEDDING.	MODERATE TO RAPID	MAY HAVE HIGH WATER TABLE.
6	LACUSTRINE SHORE DEPOSITS	SEDIMENTS TRANSPORTED BY WATERCOURSES FLOWING INTO GLACIAL LAKES AND SETTLING; WAVE ACTION ALONG SHORES.	DELTAS, BEACHES, BARS; LOW RIDGES; BERMS; FLAT TO GENTLY UNDULATING PLAINS.	HIGH ON VALLEY WALL; EDGES OF VALLEY FLOOR. EDGES OF LOWLANDS.	SILT TO COBBLE; MOSTLY FINE SANDS AND SILT, LITTLE CLAY WELL-SORTED BEDS; DISTINCT LEVEL OR SLOPING STRATIFICATION.	MODERATE TO RAPID	MAY BE UNDERLAIN BY LACUSTRINE CLAYS.
6/7	LACUSTRINE SHORE DEPOSITS OVER LACUSTRINE BOTTOM SEDIMENTS	SEE CHARACTERISTICS FOR EACH TERRAIN UNIT					SAND AND SILT COVER LESS THAN 3 FEET THICK OVER SILT AND CLAY
7	LACUSTRINE BOTTOM SEDIMENTS	SEDIMENTS DEPOSITED IN DEEP, QUIET WATER OF GLACIAL LAKES.	FLAT TO GENTLY UNDULATING PLAINS.	VALLEY WALLS; VALLEY FLOORS; LOWLANDS.	CLAY TO FINE SAND; MOSTLY SILT. WELL-SORTED BEDS; NEARLY HORIZONTAL, DISTINCT STRATIFICATION.	SLOW	LAMINATIONS COMMONLY CALLED "VARVES."

GENERAL TERRAIN UNIT CHARACTERISTICS

MAP SYMBOL	TERRAIN UNIT	MODE OF ORIGIN	LANDFORMS	COMMON TOPOGRAPHIC POSITION	PARTICLE SIZE AND DISTRIBUTION	RELATIVE PERMEABILITY	REMARKS
7/1	LACUSTRINE BOTTOM - SEDIMENTS OVER THICK TILL	SEE CHARACTERISTICS FOR EACH TERRAIN UNIT					SILT AND CLAY COVER LESS THAN 3 FEET THICK OVER GLACIAL TILL
10	RECENT ALLUVIAL DEPOSITS	SEDIMENTS DEPOSITED BY FLOODWATERS.	FLOODPLAINS SUBJECT TO OVERFLOW.	ALONG WATERCOURSES.	CLAY TO COBBLES; MOSTLY SAND AND SILT; ORGANIC SURFACE. WELL-SORTED BEDS; WEAK STRATIFICATION. FINER TEXTURES FARTHER FROM WATERCOURSE.	VARIABLE; HIGH WATER TABLE.	USUALLY UNDERLAIN BY ADJACENT DEPOSITS.
13	ORGANIC DEPOSITS	ACCUMULATION OF ORGANIC AND INORGANIC MATERIAL IN BODY OF WATER	DEPRESSIONS	ALONG WATERCOURSES HEADWATERS OF UPLAND STREAMS; VALLEY FLOOR DEPRESSIONS.	CLAY TO FINE SAND; ORGANIC MATTER; POSSIBLY MARL. UNSORTED; IRREGULAR STRATIFICATION.	VARIABLE; HIGH WATER TABLE.	
17	MAN MADE FEATURES	USUALLY OCCURS ADJACENT TO BARGE CANAL AS TOW PATH EMBANKMENTS, SPOIL BANKS, CUT SLOPES OR BORROW PITS.					ASSOCIATED WITH ALLUVIAL LANDS
18	URBAN LAND	THE HIGH DEGREE OF URBAN DEVELOPMENT HAS COMPLETELY MASKED THE ORIGINAL TERRAIN UNITS.					
1PD 5PD 6PD 7PD 10PD	POORLY DRAINED VARIANT	THESE ARE THE POORLY DRAINED PHASES OF THE ABOVE TERRAIN UNITS. THEY ARE SIMILAR IN CHARACTER TO THE DESCRIBED UNIT EXCEPT THAT THE SOIL REMAINS WET FOR A LARGE PART OF THE TIME. THESE SOILS ARE USUALLY WATER LOGGED DURING LATE FALL, WINTER AND EARLY SPRING. THE WATER TABLE REMAINS NEAR THE SURFACE EXCEPT DURING THE USUALLY WARM DRY MONTHS.					

PHYSIOGRAPHY, SOILS AND DRAINAGE

The study area is located in the Erie-Ontario Lowland Physiographic Province of the state. The canal lies on the Lake Ontario Plain and only enters the Lake Erie Plain after passing through the Lockport locks which carry it over the Niagara Escarpment.

The topography is controlled by the non-consolidated surficial deposits and not by the bedrock which is essentially flat lying. The non-consolidated deposits are the result of either direct glacial deposition or deposition in glacially associated lakes. Post-glacial erosional processes have shaped the landscape to its present configuration.

The glacial depositional history of the area was one of direct deposition of ground moraine (basal till) by the glacier, followed by the construction of ridge moraines and ice-contact features wherever the ice stagnated. The drainage was generally toward the north, and upon retreat of the ice-front pro-glacial lakes were formed with the ice as their northern barrier. As the ice retreated and outlets were found, the lakes drained to successively lower levels. Fine-grained sediments were deposited in the lakes and fine sand and silt on their shores. The last of these lakes, Lake Iroquois, was of a longer duration than its predecessors so that it developed a definite beach ridge which is followed rather closely by Route 104.

The soils have formed on the unconsolidated deposits of Pleistocene and Recent ages. The study area may be divided into smaller groupings:

1. Lock 33 (Sta. 2222) - vic. P.C. tracks (2563)
   Soil formed in clayey lake-laid deposits.

2. Vic. P.C. tracks (2563) - vic. Larkin Cr. (3160)
   Soil associations formed in glacial till.

3. Vic. Larkin Cr. (3160) - vic. Rte. 260 (3536)
   Soils founded on glacio-fluvial deposits except in the vicinity of Spencerport where glacial tills predominate.

4. Vic. Rte. 260 (3536) - vic. Co. (Orleans) line (3805)
   Soils formed on glacial till.

5. Vic. Orleans Co. line (3805) - vic. Hulberton (4030)
   Soils formed on glacio-fluvial deposits except in the vicinities of Moorman Cr. and Sandy Cr. where the soils are of glacial till origin.

6. Vic. Hulberton (4030) - vic. Gaines Basin (4560)
   Soils formed on glacial till deposits.

7. Vic. Gaines Basin (4560) - vic. Niagara Co. line (5170)
   Soils formed on lacustrine deposits except in the vicinity of Oak Orchard Creek and Jeddo Creek where the soils are of glacial till origin.

8. Vic. Niagara Co. line (5170) - vic. Orangeport (5620)
   Soils formed in glacial till.

9. Vic. Orangeport (5620) - vic. Lockport (5800)
   Soils formed in lake-laid silts and fine sands.

10. Vic. Lockport (5800) - vic. Lockport (6000)
    Soils formed in glacial till.

See Appendix , Generalized Terrain Map for more detailed information.

The general trend of the drainage in the area is northward into Lake Ontario. This is carried by a system of streams which pass under the canal. In the vicinity of Rochester the drainage passes into the Genesee River which conducts it into Lake Ontario. The only surface water passing into the canal proper is Red Creek at the junction of the Genesee River.

The principal watersheds proceeding westerly are:

Black-Paddy Hill Creeks
Braddocks Bay
Bald Eagle - Sandy Creeks
Oak Orchard Creek
Johnson Creek
Eighteen Mile Creek.

Appendix B

STABILITY OF CANAL EMBANKMENTS DURING EARTHQUAKE CONDITIONS

The section of the canal covered in this report is situated in an essentially stable zone with respect to earthquake activity (Ref. 1). The stability of the canal embankments in the study area during an earthquake has been analyzed using two distinct methods; liquefaction potential and lateral acceleration.

Most of the failures of and displacements in earth dams caused by earthquakes have been ascribed to liquefaction. The potential for liquefaction of the Barge Canal embankments has been analyzed in accordance with the methods presented in Ref. 2. It has been found that, in order not to liquefy during the design earthquake, the foundation and embankment soils have to exhibit a minimum penetration resistance of 2 blows per foot by the Standard Penetration Test used in subsurface soil explorations. The soils encountered in the borings progressed along this section of the canal meet this requirement.

The analysis when lateral earthquake acceleration is applied to a potential sliding mass results in the following criteria for stable outboard slopes:

A. For embankment slopes with low groundwater levels. This criterion applies to areas where the canal section contains a relatively impervious lining, or a sheetpile wall, or where a low groundwater level is confirmed by observation wells installed in the embankment. For safety against breaching of the canal during the design earthquake, the slope of a straight line connecting the top of the lining with the outboard toe of slope should not be steeper than 1 vertical on 2-1/2 horizontal.

B. For embankment slopes with a presumed high groundwater level. These criteria apply to areas where the canal section does not contain a relatively impervious (such as Portland cement concrete) lining and where a low groundwater level is not disclosed by observation wells:

Steepest permissible outboard slope for earthquake stability

Embankment Height	Embankment top width: W* = 14' to 17.5'	Embankment top width: W* = 10' + 1/2 H**	Embankment top width: W* = 10' + H**
less than or equal to 15'	1 on 3	1 on 3	1 on 2***
more than 15'	1 on 3-1/2	1 on 3	1 on 2***

*W = top width of embankment
**H = height of embankment
*** = if evidence of seepage is not noticeable on surface of slope

For the purpose of this earthquake stability analysis we assumed that inboard slopes would have an inclination of 1 vertical on 3 horizontal where the canal section is not lined with concrete or does not contain sheet piling.

References:
1. Fischer, J. A. & J. G. McWhorter, "The Microzonation of New York State," Microzonation Conference for Safer Construction Research and Application, Seattle, Oct.-Nov. 1972.
2. Coulter, H. W., H. H. Waldron & J. F. Devine, "Seismic and Geologic Siting Considerations for Nuclear Facilities," Fifth World Conference on Earthquake Engineering, Rome, 1973. Figure 2.5-3.
3. Seed, H. B. & I. M. Idriss, "A Simplified Procedure for Evaluating Soil Liquefaction Potential," Earthquake Engineering Research Center, University of California, Berkeley, November 1970.

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